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SODIUM AS A CONDUCTOR.

Of all substances known, whether metallic or non-metallic, silver possesses the highest electrical conductivity. Copper, however, approaches very close to it and consequently has come into general use as an electric conductor, the cost of silver being prohibitive. The specific resistance of silver expressed in microhms for a bar one centimeter long and one square centimeter in section is 1.5, whereas the value for copper is 1.6, running a little higher for hard-drawn than for annealed metal. The nearest approach to these metals is gold, which has a value slightly over 2.0, and next in order to this comes aluminum with a value variously given as 2.6 to 3.0.

These values are given in terms of the unit volume, but in industrial work it is often of more importance to consider the resistance in terms of the unit of mass, since it is upon this basis that metals are sold. Thus, while aluminum has a specific resistance nearly double that of copper its specific gravity is only 2.7 as compared with the value of 8.9 for copper. Consequently, when weight is the basis of comparison, less aluminum is required to give a cross-section of the same conductivity as in the case of copper, the ratio being about one to two. Consequently it is cheaper to use aluminum for conductor whenever its cost per pound is less than double that of copper.

When we come to consider the metal sodium we find that its specific resistance is about 4.8, or three times that of copper. Its specific gravity, on the other hand, is only 0.97, or about one-ninth that of copper. Consequently, if the cost of sodium per pound is less than three times that of copper, it would form a less expensive material for electrical conductors. With the advent of electrochemical methods of producing such metals as sodium, they can now be produced at a cost which meets this requirement. It has even been claimed that sodium could be produced in large quantities as low as twenty-five cents per pound. Its industrial use as a conductor, therefore, deserves consideration.

The chemical properties of sodium are such as to militate against its use unless some means can be devised for using it in a way entirely different from that in which we are accustomed to use copper and aluminum. Sodium has the property of spontaneous combustion when exposed to the air and consequently it is unfit for use under this condition. It

also has a low melting point, changing from a solid to a liquid at a temperature a few degrees below the boiling point of water. It is also rather chemically active and can be put into contact with only a limited number of substances without danger of chemical action. It would be necessary, for instance, not to let it come in contact with water, since it would immediately combine with the water to form caustic soda. There are thus two conditions which must be met if it is to be used, namely, it must be protected from excessive temperatures and it must be kept out of contact with the atmosphere or other material with which it would chemically react.

One scheme for handling sodium which has been proposed is to inclose it in tubes of iron, since the sodium does not react with this metal and it could thus be protected from contact with the air. The iron, of course, is assumed to form a sealed tube. While iron is our cheapest metal, it does not itself have good conducting properties, and consequently has not been utilized generally as a conductor. It is so cheap that it would seem feasible, however, to use it thus in conjunction with sodium, at least on direct-current circuits, although its high magnetic permeability might preclude its use on alternating-current circuits. There would be little difficulty in making the necessary connections at the end of such tubes when they were of large proportions, and where the cross-section was small it is quite within the range of possibilities to produce a continuous wire of sodium coated with steel in a manner similar to that in which copper-clad steel is now being manufactured. The possibilities of this use of sodium would seem to offer an interesting and profitable field of experiment for the manufacturer of electrical conductors and one which would give some promise of ultimate success.

LOWERING THE COST OF ELECTRIC COOKING.

In order to encourage the use of electric current for cooking and heating, and to avoid the necessity of separate wiring and metering for this purpose, a central station in England (the Newcastle Electric Supply Company) has adopted a two-charge method in which the meter rate is very low. The rate is offered to any residence customers who desire it, but will only prove beneficial to those having a large consumption. The charge for current will be 1.5 cents per kilowatt-hour added to a fixed charge of fifty cents for each $1,000 of assessed valuation of the house. The result of this change is tantamount to cutting the existing rate in half, but it is considered good policy to encourage electric heating and cooking on this basis, since it is regarded as a largely off-peak load. It is thought that on this basis electric current can compete successfully with either gas or coal, both for cooking and heating.

This is the kind of encouragement that will bring results, and any such announcement in an American city would result in the rapid installation of numerous current-consuming devices, and probably an early enlargement of the central station. Electric cooking apparatus has been developed to a point where little or nothing is lacking on the score of convenience and satisfactory operation, and an offer of a bargain-counter figure for operating expense would cause a rush for the most up-to-date equipment for the kitchen.

We commented some time ago in these columns upon the use of assessed valuation for fixed charges. While such a method is simple, it is not likely to find favor in this country, since more logical and equally practicable methods lie close to hand and are already in use in many places.

TWELVE YEARS OF WIRELESS.

The present month marks the twelfth anniversary of the inauguration of the first regular wireless service on an ocean liner. It may also be said to set off the beginning of the commercially successful wireless business, since the chief application of the sets at present is in communicating with ships which have no other connection with each other or the shore. Still its history and usefulness have only started.

To have an idea of the work that has been done by the wireless telegraph since its beginning, it is only necessary to review the progress made since the message was sent in 1899 from the steamship *St. Paul* to the Needles, sixty-six miles away. At present it is possible to cover several thousand miles and the process of improving sending and receiving apparatus, and the work of directing waves, are still going on. One development of recent origin was the recognition by the United States and other governments of the enormous practical value of wireless and the passage of laws compelling the use of the apparatus on vessels carrying passengers. The stimulus afforded has been directly responsible for a large amount of electrical investigation. The constructive ability awakened led to the erection of so many amateur wireless stations that they have become a nuisance and a factor with which the commercial companies have to reckon. Still such a general interest must lead to improvement.

It is rather unfortunate that the financial side of the development of wireless fell into the hands of men who had their own interests at heart rather than those of the investors or the furtherance of the art. Trusting people who knew nothing of electrical matters and very little of finance were beguiled with stories of the great success with which Bell's telephone met and were thus induced to buy stock of companies in which practically everything was mismanaged except the advertising. Yet the story of these financial promotions must be written as a page of the history of the wireless telegraph.

Its activities lie not so much in the past as in the future and the men who have worked in the past decade have but laid the foundations for a business which, with efficient management, will continue to grow and advance to the profit of mankind.

VOLT-AMPERES OR WATTS?

In the last few years the practice of expressing the capacity of alternating-current apparatus in volt-amperes has been spreading. The reason for this usage seems to be a fear that if the rating is expressed in watts it may be assumed that the apparatus will stand a load of the specified amount when run at a low power-factor, whereas, in fact, the load is limited to the nominal wattage when operated at unity power-factor. The capacity of most electrical apparatus and machinery is limited by the allowable temperature rise and this is determined by the value of the current flowing and to some extent also by the voltage at which it is operated. The effect of the latter upon the heating is illustrated in the case of a transformer by the iron loss, since the maximum flux-density, and consequently the iron loss, is dependent upon the voltage at which it is operated.

Other factors than the operating volts and amperes, however, also influence the heating of the apparatus, and consequently limit the load at which it may be continuously operated, as, for instance, the frequency, the wave form, and the temperature of the surrounding atmosphere. It must be evident that any statement of the capacity of electrical apparatus assumes certain standard or normal operating conditions of which the power-factor is one, but not the only one. It is always tacitly assumed that apparatus is to be operated at normal frequency, normal voltage and standard room temperature. In stating the capacity it is just as rational and perhaps even more so to assume unity power-factor. When capacity is stated in watts this is always understood, and consequently it conveys no additional information to state the capacity in volt-amperes. Indeed it rather tends to indicate that greater precision of statement is being made when such does not really exist, and on this ground may be considered somewhat objectionable. The mere statement of capacity in volt-amperes does not indicate any more precisely the load which the apparatus can carry, since the effect of the volts and the amperes enter separately, and to give any more full information the values of the voltage and current should be stated separately. That is to say, if the voltage be decreased and the current increased in the same proportion, the heating of a transformer will be altered, and it is evidently not the product of the volts and amperes but their separate values which determines this heating and which should be separately stated in order to give full information as to the capacity. It is only on the assumption of operation at rated voltage that a statement of the capacity in either watts or volt-amperes gives definite information as to performance.

It is evident then that any statement of rating which does not include full specifications really assumes a large number of conditions and any attempt to provide for variation in a single one of these conditions does not really give any more precise information as to the properties of the apparatus. A rating in watts consequently gives just as full information as a rating in volt-amperes and on the ground of brevity as well as logic may aptly be considered the preferable term.

Until the present year the Standardization Rules of the American Institute of Electrical Engineers specified that alternating-current apparatus should be rated in kilowatts, unity power-factor being understood. The only exception was where a low power-factor was inherent in the apparatus or was specified. In either case the power-factor should be stated and the rating then expressed in kilovolt-amperes at this power-factor. The new rules which were adopted this year provide that ratings should be given in kilovolt-amperes on the ground that the capacity depends upon voltage and current and yet it is not required that these shall be separately stated. This is one of the rules which was adopted by the committee without previous notice or opportunity for general criticism and its desirability seems at least questionable.

ILLINOIS STATE ELECTRIC ASSOCIATION.

The annual convention of the Illinois State Electric Association held last week in Rockford was conceded by all present to be the most successful convention so far held by that Association. The attendance of central-station men was greater then last year, and this in spite of the fact that the majority of members are located in the central and southern cities of the state.

The program of papers was exceptionally well prepared, the papers were brief and to the point and, without exception, it was evident that the authors were selected as being the men most capable of dealing with the subject and best qualified to give new angles and viewpoints of the matter, rather than those simply willing or accessible, as is true of some conventions. In connection with the program it is interesting to note that every paper save one was of a commercial nature, dealing with some pertinent feature of new business. Two subjects, "How to Get Power Business" and "The Sale of Electricity to Farmers" were in the form of symposiums. This plan of dealing with a subject has proven its value and, in the case of the Rockford meeting, the suggestions made by the authors of the papers and the discussion that was elicited should prove of exceptional value to every central-station man.

The character of the papers also denotes that commercialism in the central station is no longer unknown, at least in Illinois. It has been said that the central-station industry has suffered too long from the lack of the genuine commercial spirit. The National Electric Light Association has recognized this and as a result has established a commercial section, the work of which is well known. By following the footsteps of the national association, that is, by devoting more time to subjects of commercial interest, the state organizations will do a great deal towards the general advancement of the industry.

A full report of the convention will be found upon other pages of this issue.

REACTANCE IN ALTERNATING-CURRENT CIRCUITS.

DR. STEINMETZ'S ADDRESS BEFORE JOINT ELECTRICAL MEETING IN CHICAGO.

The joint meeting of the Chicago Section of the American Institute of Electrical Engineers and of the Electrical Section of the Western Society of Engineers that was held on the evening of October 25 was the occasion of the annual lecture by Charles P. Steinmetz before these societies. Bion J. Arnold, past president of both societies, introduced the speaker.

Dr. Steinmetz immediately delved into his subject, "Reactance in Alternating-Current Circuits." In the early history of alternating-current distribution, when frequencies of 133 and 125 cycles per second were common, reactance was looked upon as an unmitigated evil; now it has come to be one of the most reliable safeguards in large and powerful alternating-current systems. Dr. Steinmetz explained the meaning of reactance and showed that for a long time its significance was not understood. Taking up a brief historical review of the types of commercial circuits, he made clear why the old high-frequency system required a reduction of reactance to as low a value as possible. In sixty-cycle circuits it became less troublesome. The reactance of transformers has been gradually reduced, so that now in some instances it is but two or even only one and one-half per cent. The same is true in generators. When the reactance and resistance are nearly equal in a circuit, the former becomes practically insignificant as a source of trouble.

If properly designed, reactance may be made very useful in a circuit instead of being an evil. For instance, in the regulation of synchronous converters in railway substations reactance coils are very successfully employed to maintain a practically constant direct-current voltage under variable load.

Reactance is a decided aid in synchronizing machines. In modern large turbo-generators the internal reactance is now quite low, in some cases being only two or three per cent, and the resistance is only part of one per cent; consequently the synchronizing power between such machines in a station is very great. In the case of generators installed in different stations that are connected by leads of relatively high resistance, the synchronizing power becomes small and such stations are easily thrown out of step. This evidently requires the introduction of reactance in the tie circuits.

All arc lamps intended for multiple circuits require in series with the arc a ballast or steadying device to overcome the inherent instability of the arc. In direct-current lamps this is necessarily in the form of a power-consuming resistance, but in alternating-current lamps a reactance may be used without loss of power though at the sacrifice of the power-factor.

At the entrances to stations it is now customary to install choke coils which have a practically negligible reactance to the ordinary working currents, but present a large reactance to high-frequency surges such as lightning discharges. However, such choke coils have sometimes had a form that acted as a condenser when subjected to very high frequencies, and consequently allowed a destructive surge to pass through them.

In all large high-power distributing systems the reactance is now quite low. The possibilities of very severe damage from the sudden concentration of enormous power in a cable breakdown or other short-circuit are therefore great. It is impossible to design switches that can open a circuit carrying millions of kilowatts at short-circuit. The introduction of power-limiting reactances is therefore necessary. It becomes a question of economy whether this added reactance shall be secured by increasing the internal reactance of generators and transformers or by inserting it externally. In most transformers it is possible to increase the internal reactance to the required value instead of adding it outside. In the case of large high-speed generators, however, it is uneconomical to increase the internal reactance a great deal; by modification of the design it is feasible to increase it to, say, three and one-half or four per cent. As it is highly desirable to limit the short-circuit current to twelve times full-load value, it is necessary to have a total reactance of about eight per cent, of which about half must be installed externally in a separate plain reactance coil, compensator or auto-transformer, or regular step-up transformer, the reactance and generator in any case constituting a complete unit.

First Wireless on an Ocean Liner.

A recent issue of *Marconigraph* tells of the sending of a wireless message from the liner *St. Paul* to a shore station at the Needles, the first regular wireless communication which was ever established between a liner at sea and a shore station. The ship, sailing from New York to Southampton, was sixty-six miles from the English coast when the first message was sent. This took place on November 15, 1899.

On that trip of the *St. Paul* the first issue of the *Transatlantic Times* was printed, some of the news items therein relating to the Boer war, which was then in progress. Mr. Marconi himself was in charge of the apparatus on the ship, Major Flood-Page looking after the station equipment.

National Electrical Contractors' Association.

The Executive Committee of the National Electrical Contractors' Association held its meeting at Memphis, Tenn., October 16 and 17, and many important matters relative to the Association's future were taken up.

Fifteen months ago, the organization had a membership of 525, and is now starting on its two-thousand mark. The members are enthusiastic, and something for their good is constantly being planned and executed.

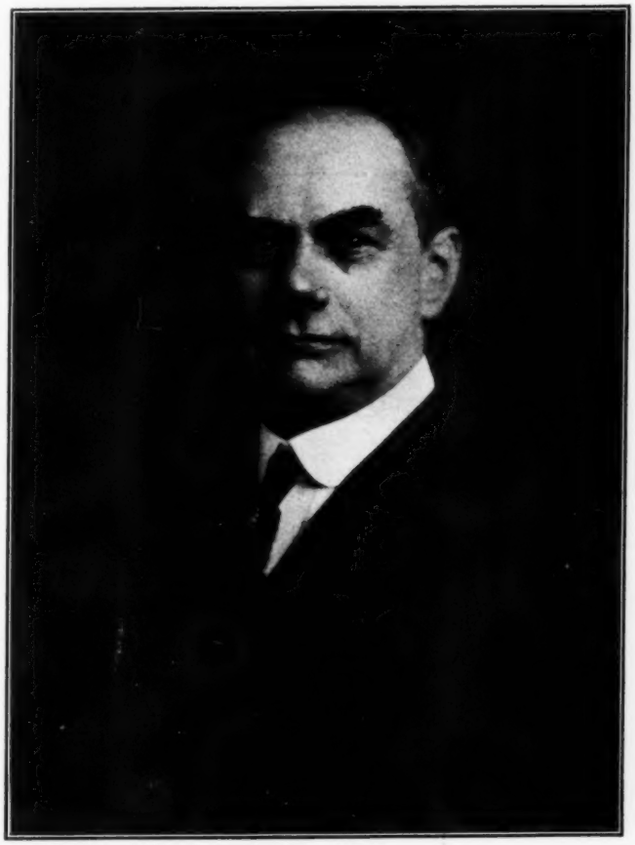
It was the Contractors' Association that started the plea of co-operation, which is today being followed out by all branches of the trade, and which is accomplishing an immense amount of good. The Standard Symbols for designating outlets, the "Universal Data and Sales Book," "The Electrical Equipment of the Home," the changing and condensing of Underwriter's rules, and many other good things have been brought out for the benefit of the trade, and the Committee is now working on a scheme to publish and endeavor to standardize the carrying capacity of cable in conduit, of all sizes and wiring systems, which will be of untold benefit to both contractor and architect.

Great interest is being taken in the next annual convention of the Association, to be held at Denver, next July, which promises to be one of the greatest in attendance in its history.

It was decided to hold the next Executive Committee meeting at Cleveland in March.

William L. Abbott.

Although the office of chief operating engineer of the Commonwealth Edison Company, Chicago, carries with it the general supervision of all of the operating departments of the company, representing thousands of employees, the multitudinous duties of this office have not prevented its incumbent, W. L. Abbott, from devoting considerable time to important public affairs. In 1904 Mr. Abbott as the candidate of the Republican party, was elected a member of the Board of Trustees of the University of Illinois for a term of six years, and at the election in 1910 was returned to office. In 1907 he was elected president of the Board, which position he still holds, having been re-elected each successive year. It is needless to add that Mr. Abbott is a staunch champion of engineering education.



WILLIAM L. ABBOTT,
Chief Operating Engineer, Commonwealth Edison Company.

William L. Abbott was born February 14, 1861, near Morrison, Ill., in Whiteside County. His parents were Asa M. Abbott and Sarah Sperry Abbott. Mr. Abbott attended the public schools in the vicinity of Morrison, later entering the Northern Illinois College, at Fulton, where he received academic training preparatory to entering the University of Illinois. He was graduated from the latter institution in 1884, having taken a four-years' course of instruction in engineering. In 1904 the University of Illinois granted Mr. Abbott a Master's Degree in Mechanical Engineering.

Upon graduation Mr. Abbott worked as machinist and later as draftsman for various firms in Chicago, prominent among these being the Pullman Company and the Van Depoele Electric Company. While with the latter company he became impressed with the possibilities in the electrical field, and in the fall of 1885, in company with F. A. Wunder, organized the Wunder & Abbott Illuminating Company. This company supplied arc-lighting service to the downtown district of the city, later absorbing several smaller companies engaged in the same business. In 1887 the Chicago Arc Light & Power Company was organized and Mr. Abbott disposed of his interests in the Wunder & Abbott Company to this corporation.

During the summer and fall of 1887 Mr. Abbott superintended the construction of lighting plants in Fort Wayne, Ind., and Springfield, Ohio, this work being done for the Ball Electric Light Company and the Thomson-Houston Company, respectively. Upon completion of this work he again formed a partnership with Mr. Wunder and with T. Edward Tuttle organized the National Electric Construction Company, to do general electric construction work. This company soon acquired ownership of a small electric lighting plant operating in the downtown district, which, under the leadership of Mr. Abbott developed in a short time to one of considerable proportions.

In 1889 Messrs. Tuttle and Wunder disposed of their interests in the business to Mr. Abbott, who conducted the affairs of the company until 1894. In this year the Chicago Edison Company purchased the National Electric Construction Company, Mr. Abbott continuing as president and general manager of the construction company for another year, in which time he was also the assignee of the Western Light & Power Company, a central-station company which had had a short but spectacular life and which ended quite disastrously.

In 1895 the business of the National Electric Construction Company was completely absorbed by the Edison Company and the former company went out of existence. Mr. Abbott was then appointed chief engineer of the Harrison Street power house. It is interesting to note that this station, having a total generating capacity of 6,000 kilowatts was, only as far back as 1895, considered a very wonderful plant. Today, the total capacity of that station is less than one-third the capacity of a single unit in the northwest station of the Commonwealth Edison Company. In 1898 Mr. Abbott was appointed chief operating engineer of the company, which position he still holds. This office carries with it general supervision of the generating and substations, transmission and distribution systems, meter department and incandescent and arc lamps.

Mr. Abbott is a member of the American Society of Mechanical Engineers, for which organization he served one term as manager, American Institute of Electrical Engineers, and Western Society of Engineers, in which he has filled several offices, and is a past president. He has read many papers on various subjects before these and other societies. In October, 1906, his paper entitled, "Some Characteristics of Coal As Affecting Performance with Steam Boilers," read before the Western Society of Engineers, was awarded the Chanute medal.

Mr. Abbott is also a member of the Chicago Athletic Association, University Club of Chicago, Engineers' Club, the Electric Club of Chicago, and the Association of Commerce.

Los Angeles Traction Report.

A traction report for the City of Los Angeles, Cal., showing the conditions now in force, and making comprehensive recommendations for the betterment of the service, was submitted to the City Council of Los Angeles on October 24, by Bion J. Arnold, who carried out the work. The city has grown remarkably in the past ten years, and prospects are that it will become a vastly more important center than it is at present. According to Mr. Arnold's report sweeping changes will be necessary if the street railways are properly to care for their traffic.

The situation was outlined by Mr. Arnold in what he designated as a "Comprehensive and Constructive Transit Plan." Some of these suggestions were as follows:

MAIN STREET CONGESTION.

1. Make every effort to relieve at once the congestion on Main Street by placing tracks on San Pedro Street and using the rear entrance into the present Pacific Electric terminal building for the interurban cars.

2. Insist upon a transfer agreement between "red lines" (Pacific Electric Railway) and the "yellow lines" (Los Angeles Railway).

3. Secure the re-routing of the local street cars so as to do away with the curves in the downtown business districts.

RIGHT OF WAY—CITY TO HARBOR.

5. Secure a right of way at minimum cost between the city limits of Los Angeles and Wilmington. This right of way should be 250 feet wide in order to provide for eight tracks and automobile highways free from grade crossings on either side. Co-operate with the county highway commission to provide an auto speedway and a motor truck highway from Los Angeles to the sea.

6. Continue with the design of the Wilmington-San Pedro terminals in conjunction with the development of the harbor plans so as to make it possible to receive and deliver cars from and to any transcontinental railroad. The influence of the opening of the Panama Canal upon transportation and upon the amount and character of the growth of the district must have constant attention.

PERMANENT TERMINAL PACIFIC ELECTRIC SYSTEM.

7. Encourage the Pacific Electric Company to develop and disclose plans for a permanent terminal for its northern, southern and Santa Monica divisions, and if these plans require franchises to enable these high-speed lines to be removed entirely from the street grade, the franchises should be liberal in their conditions, particularly in regard to length of grant, in order to encourage private capital to invest in these permanent improvements on practically private property.

SPUR TRACKS.

10. The city should encourage the building of a comprehensive spur-track system as fast as necessity demands. It is not unreasonable to expect that eventually the entire terminal tracks of the industrial district will be pooled into one holding company—the investment reduced to a minimum and switching service secured probably by electric locomotives at the lowest possible actual cost.

11. A movement should be started looking forward to the location of a union depot in the vicinty of the Plaza.

GRADE SEPARATION BY VIADUCTS.

12. Prepare preliminary designs for a viaduct on Fourth Street from Main Street to Boyle Avenue and discuss the building and financing of this viaduct with the property owners affected and with both the street and steam railroads.

13. Through the city engineer's office, establish the second-story level for streets throughout that part of the industrial district bounded by Los Angeles Street, First Street, the river and Seventh Street, so that new buildings in this section may be designed to secure the advantage of double-decking the streets in this district.

14. A contract ordinance should be the result of an agreement between the city and the local surface railway companies which should attain the following objects:

a. The best street car service at the lowest cost of operation, maintenance and depreciation.

b. The protection of the actual present value of the property of the companies.

c. The complete maintenance, periodic renewals and constantly increasing efficiency of the systems.

d. Additions and extensions slightly in advance of actual need.

e. One city—one fare—universal transfers—through routes and publicity of records.

f. Public supervision which will include the regulation of the surplus earnings so as to better the service or reduce the fares.

g. Public control over plans for additional construction and equipment, regulation of contracts, rates and transfers and control of capitalization, accounts and transfer of power.

h. Right of the city to purchase the property at reasonable intervals and at a fair price.

As a result of this contract ordinance the entire surface systems should be operated and developed as one single system inside the city limits and the interurban cars should be displaced from the streets onto private rights of way.

LOCAL AND INTERURBAN LINES.

15. Different methods should be followed in determining the city's policy on the one hand toward the Los Angeles Railway, which owns a large part of the local street car lines and charges a uniform five-cent fare, and on the other hand, toward the Pacific Electric Company, which controls the interurban lines and charges a zone system of fares. It is possible that public control of the surface lines may some time develop into city ownership of the local system in its entirety.

16. Eventually the Pacific Electric Company will be the logical tenant and operator of a system of subways and open cuts which should be built and owned by the city and rented as a high-speed terminal upon terms which will pay the interest on the cost of construction and provide a sinking fund to retire the city's transit bonds.

INTERCHANGE OF RIGHTS OF WAY.

17. The four-track Long Beach line of the Pacific Electric Company now on private right of way must either be elevated, depressed or abandoned as a high-speed railway line.

18. The local lines should be allowed and expected to operate a system of light freight and package delivery between the center of the city and a system of substations throughout the city for the purpose of reducing the cost of living by facilitating the delivery of every-day commodities.

19. Reserve the river bed for the rights of way of future transcontinental steam railroads which, no doubt, will be seeking an entrance to and through the city.

20. There is nothing which will advertise the city better, affect the value of real estate more widely and leave a more lasting impression on the entire community than a definite and comprehensive city and district plan. A city and district planning commission should be organized

Cleveland Section Meeting.

On Monday evening, October 23, the Cleveland Section of the American Institute of Electrical Engineers held its regular monthly meeting in the auditorium of the Engineering Building of the National Electric Lamp Association, at the invitation of the latter. The technical program consisted of a paper on "Industrial Lighting," by C. L. Eschleman of the Adams-Bagnall Electric Company and a paper on "The Choice of an Illuminant," by Irving H. Van Horn of the Engineering Department of the National Electric Lamp Association, followed by discussion on both papers.

Mr. Eschleman treated his subject from the standpoint of efficiency engineering, and cited statistics and personal experiences tending to prove the sacrifice of output and quality and the greater percentage of accidents in poorly lighted factories and the relatively low cost of good illumination when compared with the value of its benefits. His paper will shortly be issued in printed form. Mr. Van Horn gave a detailed analysis of the qualifications which an illuminant should possess, and gave the results of some recent tests to determine the critical frequency of visible flicker for various kinds of incandescent lamps. Both papers were illustrated by the stereopticon.

After the technical session a collation was served and a social hour was enjoyed. About 105 were present.

American Institute Meeting.

In addition to the exercises in connection with the presentation of the bronze bust of Helmholz at the meeting of the American Institute of Electrical Engineers on November 10, there will be a paper by E. F. W. Alexanderson on the subject "Magnetic Properties of Iron at Frequencies up to 200,000 Cycles." This meeting will be held as usual in the Engineering Societies Building, New York City, at 8:15 p. m.

St. Louis Electrical League.

The St. Louis League of Electrical Interests made a trip of inspection on October 28 to the new municipal free bridge across the Mississippi River.

Edison to Receive Nobel Prize.

It is reported from Stockholm that the Nobel prize for physics will this year be awarded to Thomas A. Edison.

Commercial Electrical Apparatus for 100,000-Volt Service.—II.[1]

BY STEPHEN Q. HAYES.

OIL CIRCUIT-BREAKERS.

The development of the condenser type of bushing, with its capacity distributed in such a way as to secure a practically uniform potential-gradient throughout the mass of the insulation, has greatly facilitated the design of high-tension switching devices. Due to the fact that there is practially no external static field where the lead passes through the top of the case, a cast-iron cover can be used for the switching devices with the bushings solidly clamped to the cover. This construction permits the assembling of all of the mechanism on this cover and greatly simplifies assembling and inspection.

Fig. 9 shows a large number of oil circuit-breakers installed in the 110,000-volt main switching station of the Hydro-Electric Power Commission of Ontario at Dundas. Each pole of the circuit-breaker is located in a welded-steel tank with treated linings and is complete with all of its mechanism mounted on its cast-iron top. As each pole is entirely independent, with the operating rod forming the only mechanical connection between them, the spacing of the poles of this breaker can be made to suit the station wiring. For electrical operation of these breakers, a solenoid is used for closing the breaker through a simple system of levers and links, with a pull rod connecting the poles so that all open and close at the same movement. The breaker is held in by a latch mechanism and the tripping solenoid releases the latch. All adjustments are made after the mechanism has been assembled on the cover and before the latter is placed in the tank.

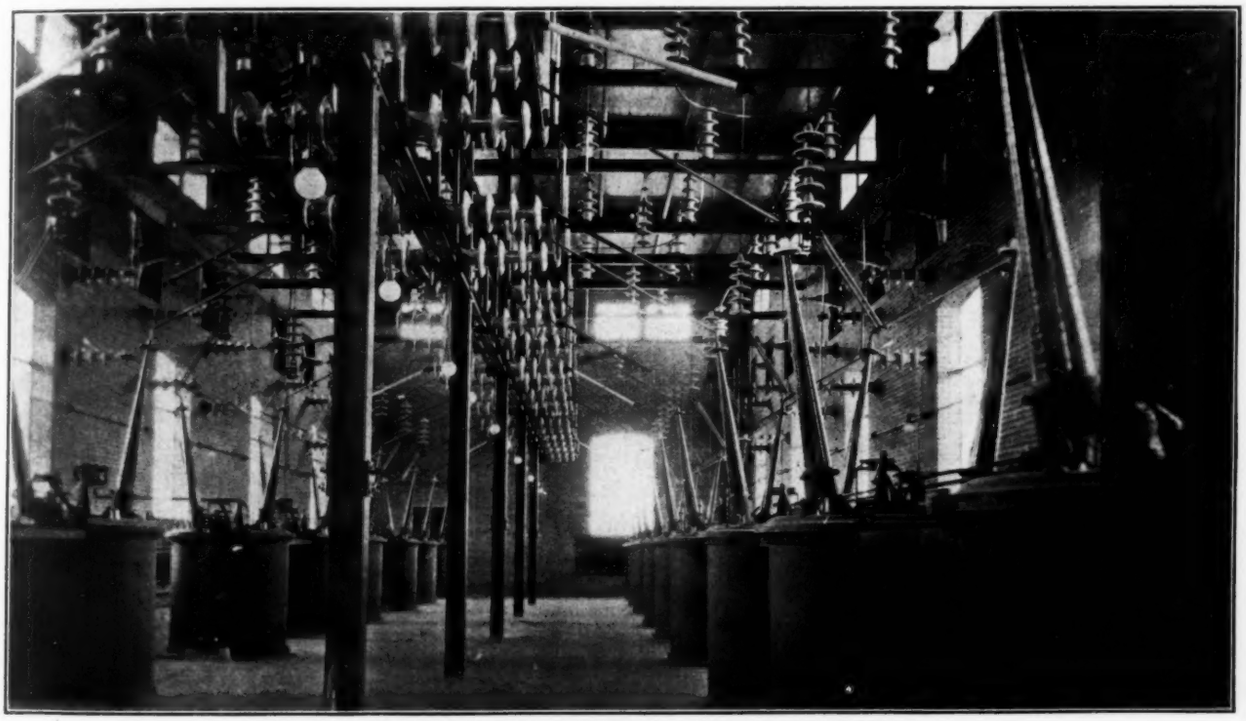


FIG. 9.—110,000-VOLT SWITCHING STATION AT DUNDAS.

The contacts, terminals and mechanism of this type of breaker have the greatest simplicity and least number of points to be insulated when compared with certain designs of European breakers requiring a large number of double breaks in series per pole. This breaker has its stationary contacts deeply immersed in oil and these are screwed directly on the end of the brass tubes that form the lead through the condenser bushings. The movable contacts are self-alining and provided with a heavy spring that is compressed when the breaker is closed. These movable contacts are carried by a heavy cross-bar and the current is transmitted to braided shunts so that the compression springs will not be damaged by the passage of current through them. When closing, a wiping motion is obtained until a solid butt contact is obtained. The stationary and movable contacts are readily renewable. Where the pull rod passes through the cast-iron covers, a stuffing box is provided that acts as a wiper in removing oil from the rods. The cover is securely bolted to a flange riveted to the upper edge of the tank and all handholes are provided with dust and moisture-proof hinged covers. The handholes in the top cover are of sufficient size to permit the ready removal of contacts and cross-bar without dismounting the other parts of the circuit-breaker. The condenser-bushing leads with the stationary terminals can readily be unclamped and removed through the cover.

One of the advantages inherent in the condenser-bushing type of insulation for the terminals of the circuit-breaker is the possibility of placing series transformers for the operation of ammeters and relays directly

1 Paper read at International Electrical Congress, Turin, Italy, slightly abridged.

around the condenser-bushing leads, which form single-turn primaries. In many cases these series transformers are located inside the tank of the breaker, permitting the use of a simple, compact and cheap form of series transformers.

Fig. 10 shows one of the outdoor type of oil circuit-breakers installed on the 100,000-volt circuits of the Southern Power Company. The condenser-bushing leads of this breaker are covered with a series of porcelain insulators and the space between the bushing and the insulators is filled with a moisture-proof compound. The operating mechanism is covered by a metallic hood, and the pull rods connecting the various poles of the breakers together pass through pipes. The various joints are made thoroughly weather-proof and outdoor breakers of this design have been operating very satisfactorily on the lines of the Dominion Power & Transmission Company near Hamilton, Ontario, the Niagara, Lockport & Ontario Power Company near Niagara Falls, N. Y., and the Southern Power Company.

from a series of link insulators. This series trip device is also shown in Fig. 9, the main switching station of the Hydro-Electric Power Commission.

It may be noted from Fig. 11 that

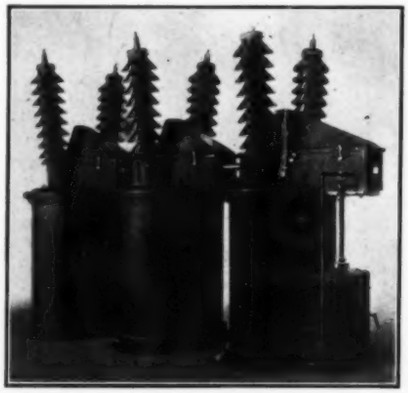


FIG. 10.—100,000-VOLT OUTDOOR-TYPE OIL CIRCUIT-BREAKER.

the height to the top of the disk at the end of the terminal of the oil circuit-breaker is twelve feet, while the disk on the right is provided with extension arm and pin for use with a suspension-insulator type of disconnecting switch.

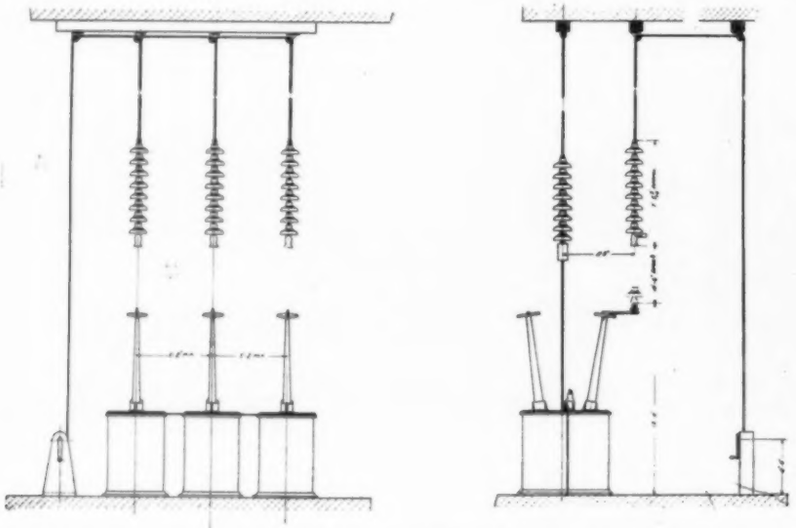


FIG. 11.—140,000-VOLT INDOOR-TYPE OIL CIRCUIT-BREAKER AND DISCONNECTING SWITCH.

Fig. 11 shows a front view and side elevation of a 300-ampere, 140,000-volt breaker arranged for hand operation and provided with suspension-insulator type of disconnecting switch. This same breaker is readily arranged for electrical operation by means of a solenoid.

The automatic tripping of this particular breaker was arranged for by means of a series trip device, comprising a solenoid in the high-tension circuit, this solenoid being suspended

The height to the end of this pin is thirteen feet and an additional height of three feet is required for the purpose of removing the condenser-bushing terminal with its contacts from the tank of the breaker.

As all circuit-breakers in actual service require a certain amount of inspection, adjustment and repair, it is customary to furnish disconnecting switches for isolating such breakers from the source of power so that they may be examined in perfect safety without shutting down of the station.

For voltages of 100,000 and above, the usual petticoat type of insulator mounted on a pin and provided with a blade-type disconnecting switch has not been found satisfactory due to mechanical reasons.

Fig. 9 shows a large number of disconnecting switches mounted on porcelain pillars in the 110,000-volt switching station of the Hydro-Electric Power Commission. For still higher voltages a somewhat different type of disconnecting switch is usually found more satisfactory.

Fig. 11 illustrates the suspended type of disconnecting switch used for isolating the 140,000-volt oil circuit-breakers previously referred to. The main features of this type of switch

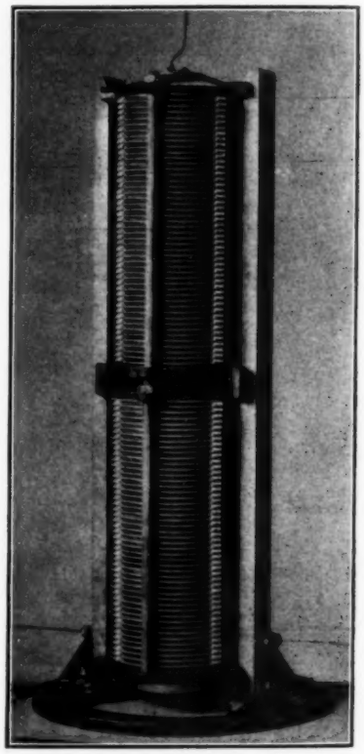


FIG. 12.—ALUMINUM TRAYS FOR ELECTROLYTC ARRESTER.

consist of a series of suspension link insulators with a funnel-shaped contact at the end. This funnel-shaped contact can be dropped over a pin contact attached to the condenser-bushing terminal of an oil circuit-breaker or transformer. A flexible lead connects from the funnel-shaped movable contact to the busbars or other source of power. With an arrangement of this type, two or more single-pole switches can be operated as a multiple-pole switch and a suitable signal device can

readily be arranged to indicate by means of a lamp or other device on the switchboard whether the disconnecting switch is in the open or closed position. If desired, this switch can readily be operated by a small motor or solenoid and can readily be arranged to be interlocked with the oil circuit-breaker.

LIGHTNING ARRESTERS.

The question of the protection of transformers, switching stations and transmission lines from the effect of lightning or other high-potential surges is one of importance and is usually considered in connection with the switching equipment.

Various types of lightning arresters have been developed for this service and Fig. 13 shows an installation of electrolytic lightning arresters installed for the protection of the 110,000-volt transmission lines of the Hydro-Electric Power Commission of Ontario.

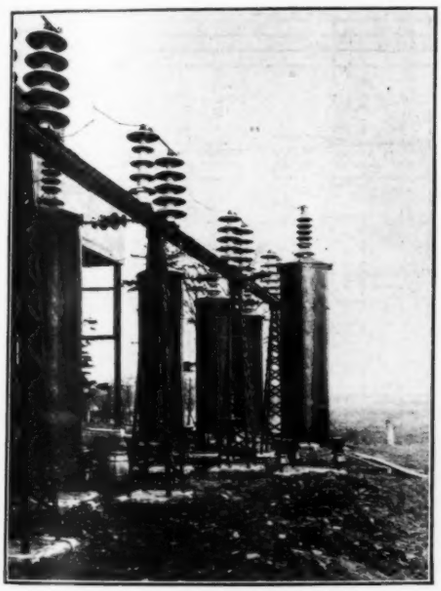


FIG. 13.—110,000-VOLT ELECTROLYTIC LIGHTNING ARRESTERS.

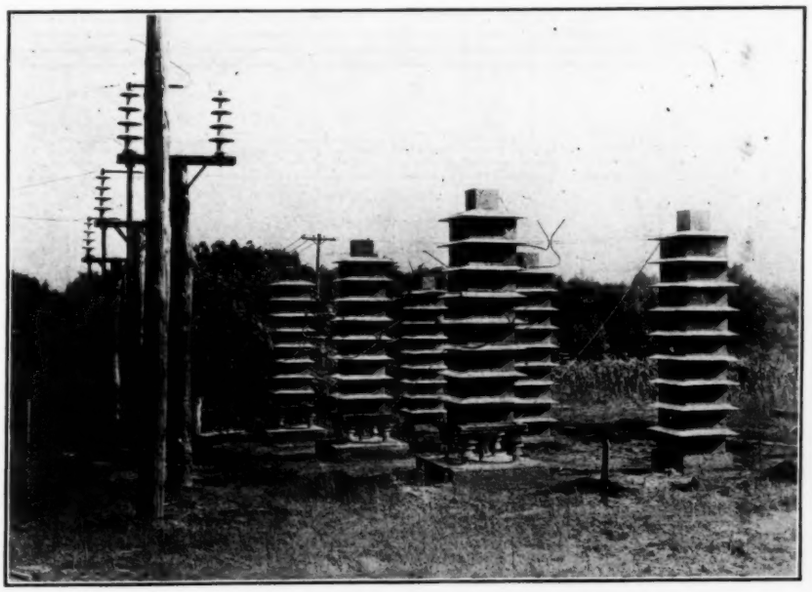


FIG. 14.—100,000-VOLT CONCRETE-COLUMN ARRESTERS.

These lightning arresters are provided with a horn-gap device usually mounted on a pipe framework and arranged so that the length of gaps can easily be adjusted while the arrester is in service. The arrester itself consists essentially of a system of nested aluminum cup-shaped trays as shown in Fig. 12, suitably supported and arranged in a steel tank. These trays contain a liquid electrolyte which forms insulating films on their surfaces, which films prevent passage of current at normal voltages. These films break down at abnormal voltages and form a free path for these abnormal voltages or static discharges. On the cessation of the abnormal stress the film regains its original resistance. It may be noted from Fig. 13 that these arresters are arranged for outdoor service. The aluminum trays filled with electrolyte are completely immersed in transformer oil contained in the steel tanks. This oil provides for insulation and cooling and prevents evaporation of the electrolyte. The volume of oil in the tanks, which are nearly filled, is great enough to absorb the heat due to a continuous discharge for a long period.

It is usually necessary to charge this type of arrester periodically for the purpose of maintaining the film of oxide on the aluminum plates, and the horn gaps are readily adjustable so that in one position the line current will arc across the gaps and charge the cells. In a second position the gaps are so set as to discharge only at a predetermined point slightly above the operating voltage, while in the third position of the horn gaps, the gap is so large as to prevent the possibility of arcing across and in this manner act as a disconnecting switch when it is necessary to inspect the tanks containing the electrolytic cells.

Where a somewhat cheaper form of lightning arrester is required for extremely high voltage and outdoor service it is possible to adopt the arrangement shown in Fig. 14, which illustrates some of the three-phase lightning arresters on the 100,000-volt system of the Southern Power Company. With this type of arrester. instead of providing aluminum cells placed in steel tanks, resistances are located in the circuits between the line horn gaps and ground, these resistances being built up in the form of large columns having a large cross section and great heat-absorbing capacity. Two columns in series are used between line and ground in each phase. The columns in question are made of a special mixture of concrete and red oxide of iron and as indicated, a column is divided up into a number of sections by expanded metal imbedded in the concrete. The edges of this expanded metal are riveted to sheet-metal eaves which prevent water running down the sides of the concrete and thereby obviates the variation in resistance due to the concrete becoming water-soaked. These sheet-metal eaves serve also as terminals for the shunt horn gaps. All metal that is susceptible to rust is galvanized. The operation of these arresters is on the same principle as other shunted gap arresters, that is, a light discharge passes over the series gaps and through the resistances, heavier discharges pass over one or more of the shunt gaps, and direct stroke will probably pass over all the shunted gaps. The arrester, after once being adjusted, will require no attention or care whatsoever, and is designed to give such rugged construction as to make it almost impos-

sible that it should be seriously damaged by any discharge which would pass through it. An additional feature of the resistance column is that it has a high resistance for low voltage and a low resistance for high voltage, giving in fact a partial safety-valve effect within the resistance itself.

The question of the necessity for or advisability of the use of lightning arresters of any kind on extremely high-voltage lines is a debatable one, particularly if the amount of power on the transmission line is limited. With a comparatively small amount of power, the normal full-load current on a high-tension line is comparatively small, and any lightning discharge passing through an arrester, with the current which momentarily follows it, may absorb practically the entire power of the system, interfering with the delivery of power and in some cases causing the tripping of automatic breakers in the power houses, practically shutting down the transmission system.

STATION ARRANGEMENTS.

A few typical examples showing the arrangement of high-tension stations with their connections, control desk, etc., may be of interest.

Fig. 15 shows the main connections of a plant with two 500-kilowatt, 250-volt exciters, six 10,000-kilowatt, 6,600-volt, three-phase generators, six banks each of three 3,333-kilowatt, single-phase transformers, delta-connected in low tension, star-connected in high tension, and four 20,000-kilowatt, 110,000-volt, three-phase transmission lines.

Following the usual practice in plants of this size the switchboard, properly so-called, is made in the form of a control desk. The top slab of this desk is made of marine-finished slate, with the operating handles and dial plates of the circuit-breaker and other controllers mounted on the top and front of the desk, while the controllers themselves are inside the desk, so that there is absolutely no liability of the station attendant coming in contact with the 250-volt operating circuit while working on the front of the desk. As all of the instruments, synchronizing equipment, etc., are operated from series and shunt transformers, there is no danger of the operator being able to touch any live circuit even of low voltage.

On the front portion of the desk are

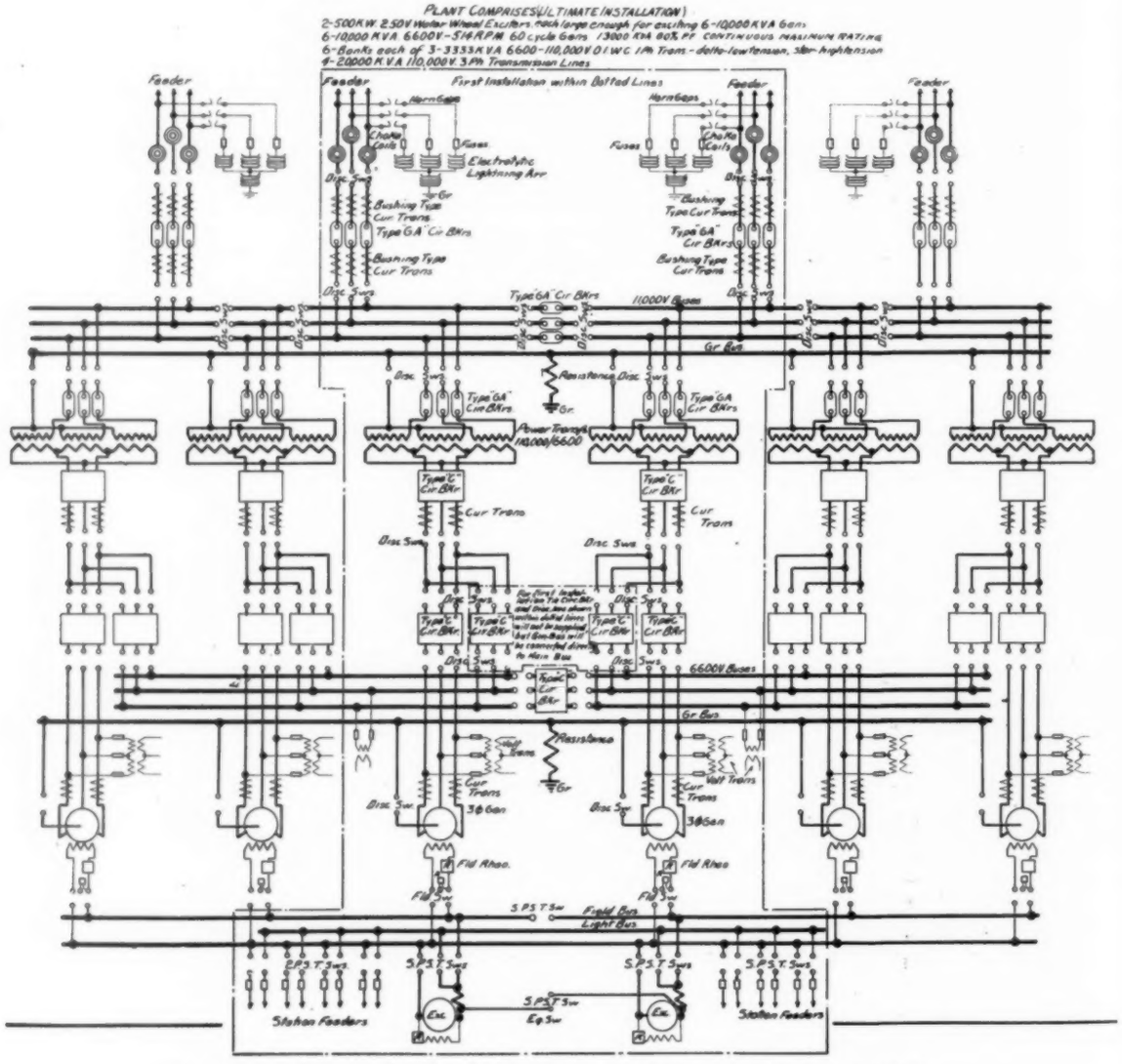

PLANT COMPRISES ULTIMATE INSTALLATION
2-500 K.W. 250 V Water Wheel Exciters, each large enough for exciting 6-10000 K.V.A. Gens
6-10000 K.V.A. 6600 V-514 R.P.M. 60 cycle Gens 13000 K.V.A. 80% P.F. CONTINUOUS MAXIMUM RATING
6-Banks each of 3-3333 K.V.A. 6600-110,000 V D I W C 1 Ph Trans - delta-low tension, star-high tension
4-20000 K.V.A. 110,000 V. 3 Ph Transmission Lines
First Installation within Dotted Lines
Feeder
Horn Gaps
Choke Coils
Fuses
Electrolytic Lightning Arr
Disc. Sws
Bushing Type Cur Trans
Type "GA" Cir Bkrs
11000 V. Buses
Gr. Bus
Resistance
Power Trans 110,000/6600
Type "C" Cir Bkr
Cur Trans
6600 V Buses
Volt Trans
3 Ø Gen
Fld Rheo
Fld Sw
S.P.S.T. Sws
Field Bus
Light Bus
Station Feeders
Exc.
Eq Sw

FIG. 15.—DIAGRAM OF CONNECTIONS, 60,000-KILOWATT, 110,000-VOLT STATION.

placed calibrating jacks that enable any of the switchboard instruments to be checked and calibrated without removing them from their position, the instruments themselves being located on an instrument frame back of and above the desk at such a height that the station attendant standing at the desk can look under the instrument frame and over the desk to watch the operation of the machine which he is controlling.

Fig. 16 shows the plan view of this same generating station with its step-up transformer station.

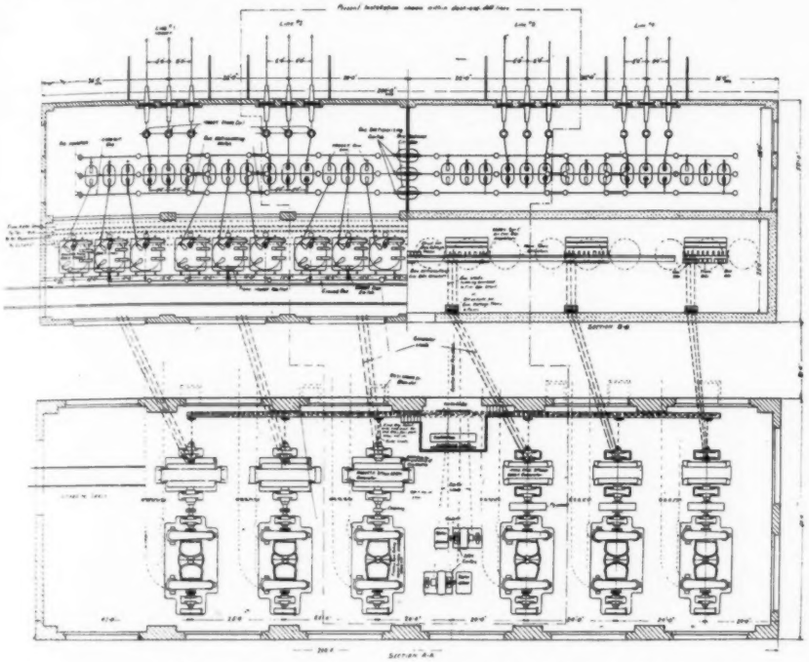


FIG. 16.—PLAN OF 60,000-KILOWATT, 110,0000-VOLT STATION.

Two exciters with their water wheels are placed in the center of the building, while the control desk, instrument stand and the panel switchboard for the exciters and field-circuit will be placed on a low balcony overlooking the generating station.

As may be noted, the generator building is separated from the transformer and switch house by a space of twenty feet in order to secure better lighting and better ventilation.

As shown on this figure, as well as in Fig. 17, it is the intention that the 6,600-volt circuit-breakers and busbars should be inclosed in masonry compartments, while the 110,000-volt circuit-breakers and busbars should be open owing to the great difficulty and expense of installing masonry structures for 110,000-volt circuits and the doubtful benefit to be obtained from such a course.

Fig. 17 shows the sectional view through this same generating and transforming station and indicates the general arrangement proposed for the apparatus in these two buildings.

As may be noted from this figure it is the intention that the generator should draw in air around the shaft and should discharge it at the bottom of the stator to a short duct connecting with the tail race. With this arrangement of discharging the heated air from the generators into the tail race and locating the field-rheostat resistances of the generators outside the building, the question of securing proper ventilation for the building is greatly simplified.

It is the intention to locate the 110,000-volt horn gaps and the tanks for the electrolytic lightning arrester on the roof of the station.

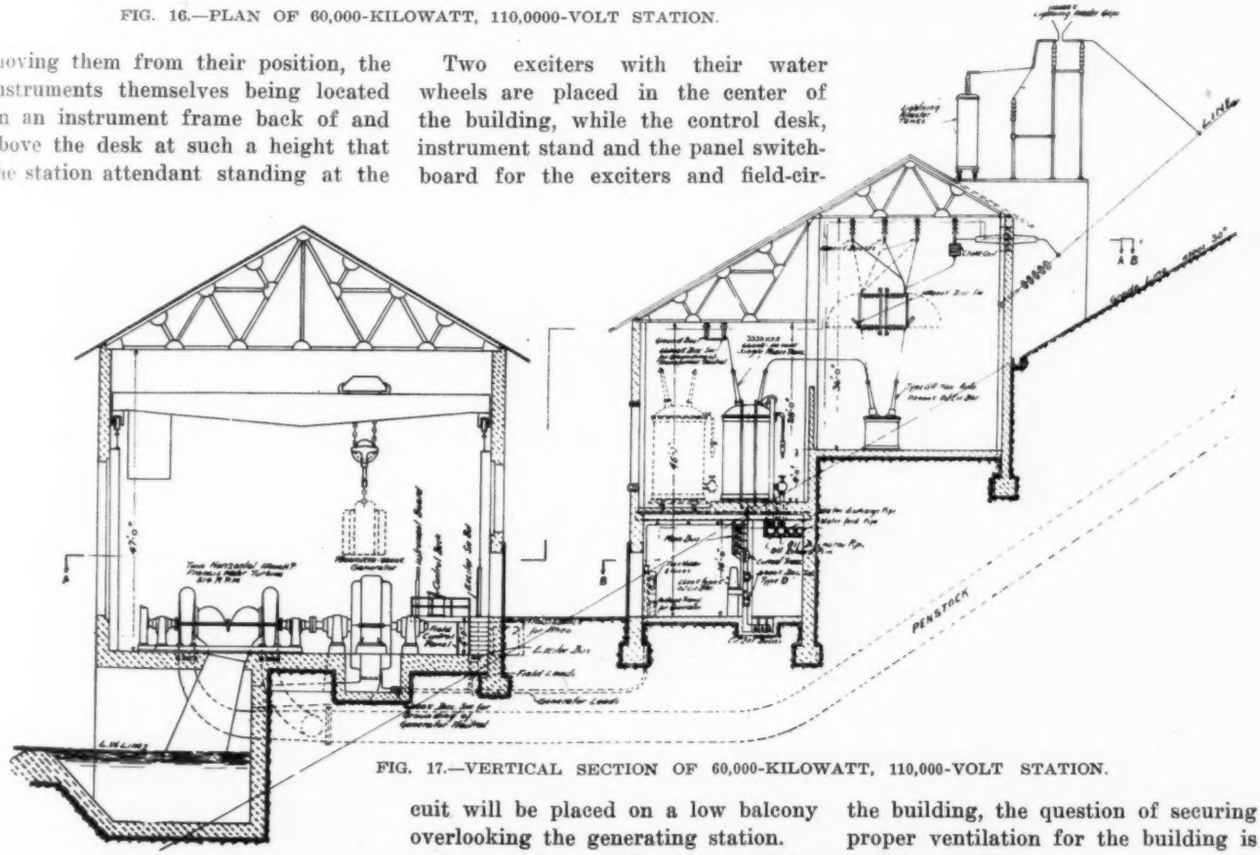


FIG. 17.—VERTICAL SECTION OF 60,000-KILOWATT, 110,000-VOLT STATION.

As shown on this drawing, the generating station and transformer house are to be erected on the side of a hill having a grade of approximately thirty per cent, and advantage of this grade is taken in the arrangement of the transformer house to minimize the amount of material required for that building.

As an example of a station designed for still higher voltages, Fig. 18 shows the arrangement of a plant taking care of two 140,000-volt three-phase incoming lines, three banks of step-down transformers and the necessary switching equipment.

In this station the electrolytic lightning arresters are located on the roof of the station, while the disconnect switches, circuit-breakers, transformers, etc., are inside the station. The general arrangement is almost self-evident from the figure.

The question of using outdoor transformer stations for extremely high voltages is one of a great deal of interest and is one that is receiving a great deal of consideration from designers.

Fig. 19 shows an outdoor station for the control of four 110,000-volt circuits, and eight 10,000-kilowatt banks of transformers.

As may be noted, the high-tension buses and the disconnecting switches are mounted on steel structures supported on towers of windmill design, while the oil circuit-breakers and transformers are located on the ground below the disconnecting switches.

Owing to the number and the capacity of low-tension circuit-breakers needed for properly distributing the 11,000-volt current in a 60,000-kilowatt installation, it was necessary to provide a small building to contain the oil circuit-breakers and busbars. For this service, the circuit-breakers and busbars have to be installed in masonry compartments, owing to the enormous current available on the buses in case of a short-circuit.

The building also contains the small local-service transformers with motor-generator sets, storage battery for the electrical operation of the main circuit-breakers, and this building also contains the switchboard on which the controlling devices for the various circuits are mounted as well as the instruments, relays, etc.

As a matter of interest it might be stated that a 44,000-volt outdoor switching station has been in service on the lines of the Dominion Power & Transmission Company in Canada and has given entire satisfaction, notwithstanding the extremely cold weather, snow and sleet storms encountered in that neighborhood. Series transformers and oil circuit-breakers are in use out of doors on the 66,000-volt circuits of the Ontario Power Company, while 100,000-volt oil circuit-breakers have been in use for some time on the circuits of the Southern Power Company.

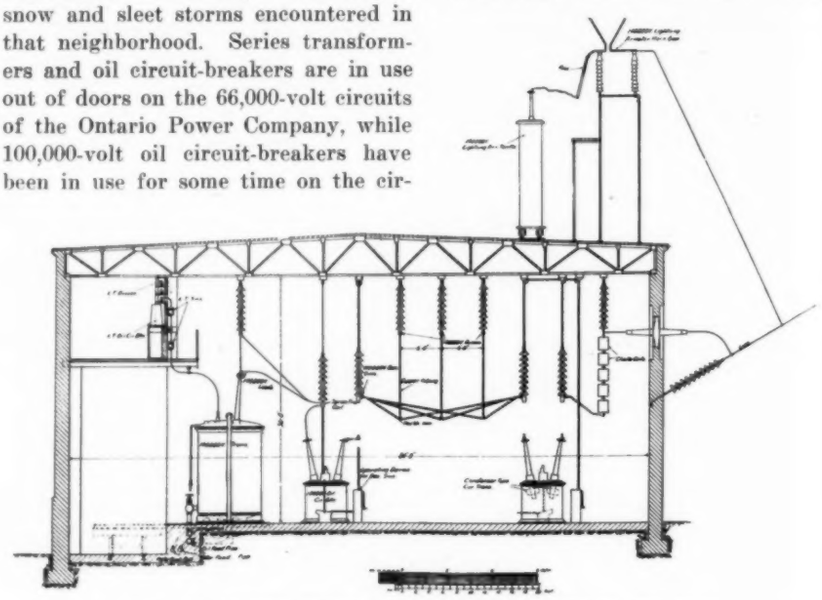


FIG. 18.—ARRANGEMENT OF 140,000-VOLT INDOOR STATION.

TRANSMISSION TOWERS.

The various power-transmission systems in America operating at 100,000 volts or above have practically no trouble due to their high operating voltages and the use of steel towers and suspension insulators makes it possible to go to considerably higher voltage if desired.

Fig. 20 shows the transmission towers, insulators and transmission lines on the 100,000-volt circuits of the Great Western Power Company in California, and it should be stated that these towers are placed 700 feet apart, each tower carrying two three-phase transmission lines, the wires of each transmission being ten feet on center while the two sets of lines are seventeen feet apart. On this line there is a transposition every 3.33 miles and a complete spiral every ten miles. This line runs a distance of about 160 miles and the step-up transformers on this line are connected in delta.

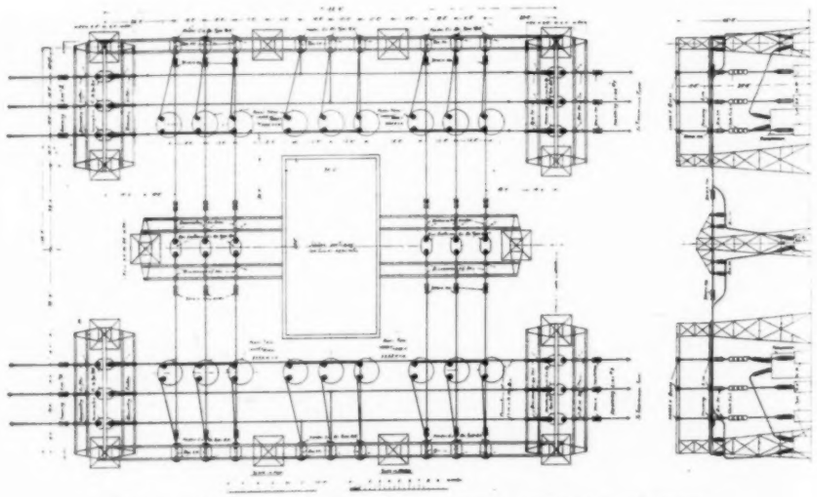


FIG. 19.—ARRANGEMENT OF 110,000-VOLT OUTDOOR STATION.

The 110,000-volt circuit of the Hydro-Electric Power Commission of Ontario is operated from star-connected transformers with ungrounded neutral, although provision is made for grounding the neutral if desired. The

standard towers are placed about 550 feet apart and have an average height of 65.5 feet while longer spans and larger towers are used in special locations. On this system there are two transmission circuits running from the step-up transformer station near Niagara Falls to the main switching station at Dundas, a distance of 52.75 miles, and two additional transmission lines will probably be installed at a later date. From Dundas two lines run to Toronto, a distance of 37.25 miles. Two transmission lines run between Dundas and London over two routes forming one complete loop, and two additional lines will be installed later. Along one route the distance between Dundas and London is 71.75 miles, but along the other route it is 109.5 miles. From London to Windsor, a distance of 142.2 miles, one transmission line has been installed and a second one will be put in later.

The distance along the transmission line from Niagara Falls to Windsor over one portion of the loop between Dundas and London is 304.45 miles, while over the other portion of the loop it is 266.7 miles. This is probably one of the longest straight-away transmission systems in actual service at present. On these towers the minimum distance between wires is eight feet and where extra-long spans are used this distance is increased up to fourteen feet. From Niagara Falls to Dundas, aluminum cable, 0.46 inch diameter, is used, while for the balance of the distance somewhat smaller aluminum cables are used.

The strain-type transmission towers on the 100,000-volt lines of the Southern Power Company carry two three-phase circuits, one of copper cable and the other of aluminum. The three wires of each circuit are located on the same side of the tower, the lowest conductor being 40 feet from the ground, the middle conductor 48 feet, and the top 56 feet. The height to the top of the tower, where the ground wire is located, is 65 feet, while the horizontal distance between the conductors is 15 feet, 8 inches. The average span between towers is 600 feet, and the maximum 1,500 feet.

The Central Colorado Power Company is transmitting power at 110,000 volts from Glenwood Springs to Denver, a distance of 153.5 miles. The Grand Rapids-Muskegon Power Company put into service the first system of transmission at 100,000 volts or above in Central Michigan and a 140,000-volt system is to be installed in the same neighborhood.

Other systems at voltages of 100,000 or higher are being proposed for various installations and engineers and designers are prepared to undertake power transmission at any voltage for which there is a commercial demand.

Electrification in Montreal.

The City Council of Montreal, Canada, has recently taken steps to abolish the smoke nuisance in that city. With this end in view the railway commissioners have been asked to pass a rule requiring the railroad companies to adopt some one of four methods of preventing smoke. One of the four is the use of electric locomotives in the city.

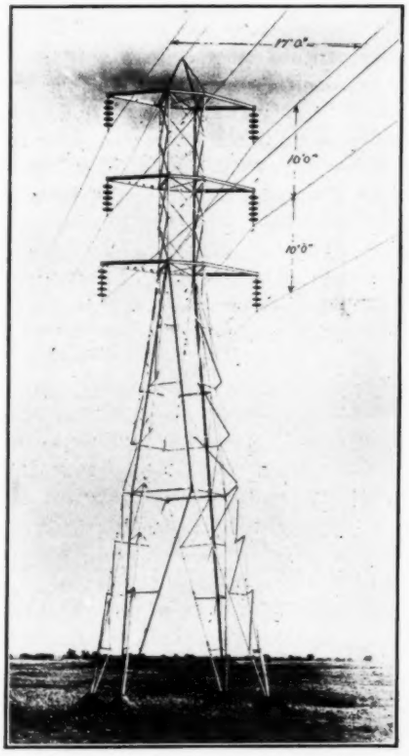


FIG. 20.—TRANSMISSION TOWER OF GREAT WESTERN POWER COMPANY.

The railroads have already been considering the matter of electrification of their Montreal terminals, but the Canadian Pacific and Grand Trunk Railroads came to the decision to do nothing for the present at least. The Canadian Northern Railway on the other hand has been considering the extension of its line to a central location for a city terminal. The adoption of electricity as motive power on this extension is very probable.

ILLINOIS STATE ELECTRIC ASSOCIATION.

ANNUAL CONVENTION AT ROCKFORD, ILL., OCTOBER 24, 25 AND 26.

The annual convention of the Illinois State Electric Association was held in Rockford, Ill., October 24 to 26. The program included many papers of vital interest to central stations and the convention was conceded one of the most successful in the history of the Association. The entertainment features were numerous and well arranged, these creating a diversion enjoyed by all present. Too much credit cannot be given the Rockford Electric Company, the host of the Association at the annual banquet, for the manner in which it provided for the comfort and entertainment of the delegates and guests.

The meetings were scheduled to be held in the basement of the Rockford Armory, the first floor being devoted to exhibits of the manufacturers, but when the convention convened at 2 p. m. Tuesday it was found that the acoustic conditions were not suitable. President W. G. Austin announced that the illustrated talk on "Power," by George B. Coleman, could be delivered and the meeting would then adjourn until Wednesday morning. Subsequent meetings were held in the lecture hall of the Unity Church.

Mr. Coleman's talk comprised a brief description of some twenty-five or thirty power installations in Rockford and elsewhere which were illustrated by lantern slides. Several cartoons on figuring power costs were also shown. There was no discussion.

WEDNESDAY MORNING.

President Austin called the meeting to order promptly at 9:00 a. m. Owing to the postponement of the papers scheduled for Tuesday afternoon a change was made in the order of business. The first matter taken up was a symposium on "How to Get Power Business." John G. Learned, of the North Shore Electric Company, T. P. Pinckard, of the Peoria Gas & Electric Company, and A. C. Martin, of the Rockford Electric Company, presented papers on this subject, in the order named, abstracts of which follow.

HOW TO GET POWER BUSINESS.

Mr. Learned's paper treats of selling electric power to industrial plants in the smaller towns and cities. The requirements of the salesmen are first discussed. The power solicitor should be selected with great care

and should be, preferably, a technical man. Suggestions are made for the method of approach and sample ledger inserts reproduced showing how isolated-plant charges should be itemized. The paper states that it is good practice to install motors on a rental basis for a trial period of from three to six months, the customer paying for the setting up of the motors and for wiring, the company doing the work at actual cost, also bringing the service to the building at its own expense. It is only in rare instances that the service once used is discontinued, provided the customer remains in business at the same premises. Attention is called to the value of co-operation on the part of the manufacturers. It is marvelous to learn of the effect on a prospect of the confirmation of the salesman's statements by one who has no apparent interest in the central station. The agents of manufacturers of motors, electrical appliances and electrically driven machinery, may be valuable assistants to the power salesman. The primary intention of the manufacturers' agents is selling motors and he can lend his assistance, directly or indirectly, to close a power deal.

BY T. P. PINCKARD.

This paper, which was presented by R. S. Wallace in the absence of the author, made a plea for consistent efforts on the part of power solicitors in securing new business. Referring to isolated plants the author states that every one shut down is a boost for central-station service. It is stated that the slowness usually evident in closing negotiations with the central station is not antagonism on the part of the prospect but rather a desire to investigate all of the conditions. This should be encouraged by the solicitor who also should make a thorough study of all conditions before proposing central-station service.

BY A. C. MARTIN.

This paper outlines a few pertinent suggestions for power solicitors. There is hardly a locality that has not been worked to a point where contracts are hard to secure. The prospects available today are more or less prejudiced against central-station service. The first step in a power campaign is to remove the cause that has created this prejudice against central-station power and this can be accomplished by securing letters from all present customers. These letters should be kept in a loose leaf note book and carried by the power man at all times so that he will have them for ready reference when the prospect alludes to some customer as being dissatisfied. These letters also act as a barometer of the condition and frame of mind of the present power users. If satisfactory letters cannot be obtained, it is a sure sign of dissatisfaction, and there is more urgent need of work among old customers than there is among prospects; for one dissatisfied user of power can do harm that several power men cannot undo. It is evident from the condition in which the majority of isolated plants are found that the owners have given the power question very little thought and it has frequently been a mistake in the past to present a proposition to these prospects too soon. When making the first call all reference to selling power should be avoided; conversation should be in non-technical terms about things electrical and should eventually lead to the conditions that exist in the prospect's isolated plant or factory, and in a round about way bring to his attention the defects of his present equipment and get him interested in the power question. A great help in interesting a man is a personal letter calling his attention to some improvement that has been made in the adaptation of electricity to his particular line. If a photograph pertaining to the subject matter is attached the mission of this letter will be accomplished even if the letter is not read. No fixed rules can be given for interesting a man, but all preliminary work should lead to the point where the prospect will consent to an indicator test of his engine. The correct cost of operating the isolated plant is the most important factor entering into the successful closing of a contract and no attempt should be made to sell power until this has been definitely determined.

Ernst. J. Berg opened the discussion describing briefly how an installation of motors had been made in a large paper mill.

Charles Monroe called attention to the importance of power data in closing contracts. He suggested that the Association take some means of collecting this data from various industries in the state and publish it for use of members. He also spoke of the value of letters from satisfied central-station customers.

Frank J. Baker moved that the secretary be authorized to write to all central stations in the state asking for the number of power customers on their lines, their address and size of installation. Mr. Baker held that this information, if published in pamphlet form by the Association, would be of great value in influencing prospects to adopt central-station service.

A. C. Martin briefly outlined the power conditions in Rockford. There are approximately thirty-six furniture factories in Rockford, this being the second largest furniture-manufacturing city in the country. Seven of these factories use central-station service. Mr. Martin explained that this business was hard to secure because the refuse from these plants furnish fuel for the greatest part of steam when the isolated plant is running and this gives the manufacturer an erroneous idea as to the exact cost of his power. There are other factories that run entirely on refuse during the day, but at night enough coal is used to make the cost of coal equal to the cost of central-station power. In this connection Mr. Martin explained that in several instances he has induced the manufacturer to save the refuse to burn at night for the dry kiln and use central-station power. Mr. Martin spoke briefly of blower motors in furniture factories and described how, in one factory, a blower installation consuming sixty-six per cent of the entire power was changed so that it consumed less than forty per cent.

Charles W. Pendell, in connection with the suggestion made previously as to the collection of data, thought that a standard form of questions could be prepared by the Executive Committee and sent to all companies. If the data was compiled in this manner it would be readily comparable.

John F. Gilchrist thought that the more information requested from central stations the fewer the replies would be, and while he appreciated the value of complete data on electricity as applied to the various industries, he thought, as a stepping stone, the Association should only compile a list of the various industries using central-station power in the various towns of the state. Messrs. Pepper and Hillman were also in favor of Mr. Gilchrist's plan.

Experiences of members in regard to power business were then asked for by President Austin. H. A. Foster drew forth the applause of the Association when he announced that the station in Fairbury had secured all the power business available in that town.

F. M. Sinsabaugh said that the Mt. Vernon company has obtained excellent results in securing power business by making a practice of placing motors on trial. Of the many motors placed in this manner none have ever been returned.

L. R. Spaulding recited an interesting incident in connection with obtaining power business, the moral of which was that a close study must be made of all conditions before central-station service is proposed. In Mount Morris an elevator company was approached in the matter of substituting an electric motor for the 7.5-horsepower gasoline engine then in use. The manager of the elevator stated that the engine ran continuously ten hours a day, and the central station based its installation, which was subsequently made, on this assumption. A fifteen-horsepower motor was installed. When the elevator was placed in operation it was found that in reality the power was used just a short time each day. Investigation disclosed the fact that the gasoline engine was run continuously on account of the trouble encountered in starting it. A comparison of power costs showed electric power to cost about as much as the kerosene burned to prevent the gasoline engine from freezing.

F. M. Sinsabaugh told of a similar experience in connection with an installation of motors in a mattress factory. Here too a gasoline engine was run continuously on account of the trouble encountered in starting.

John G. Learned spoke briefly of power conditions in the Chicago territory. Continuity of service is a pre-

eminent feature of the North Shore Electric Company's power service and perfect regulation is insisted upon in lighting service. This necessitates strict requirements as regards motors. All three-phase motors over thirty-five horsepower size must be of the slip-ring type. Mr. Learned also spoke of the assistance the motor manufacturers can give central stations in closing power contracts.

E. O. Brown described an installation in an elevator in Yates City where a gasoline engine was replaced by a motor when it was shown that the cost of fuel for the engine was $17.50 per month as compared with $8.70 for electric energy.

E. B. Hilman asked what the practice of central-station companies was regarding a minimum charge per horsepower per month where current is used only for short periods each day. E. R. Davis replied that the company with which he is connected makes a minimum charge of fifty cents per connected horsepower per month.

"The Sale of Electricity to Farmers" was the next subject taken up. Brief papers were presented by O. E. Brown, R. H. Abbott, H. W. Bullock and John G. Learned. These papers were followed by an address by E. P. Edwards on the subject of "Electricity on the Farm."

SALE OF ELECTRICITY TO FARMERS.

The electric station at Elmwood, Ill., has thirty miles of transmission lines supplying eight small towns, and incidentally some fifty farmers. All of these towns are backed by excellent and prosperous farms, whose occupants, without regard to their means or willingness, are unable to retain hired help in their households. They are therefore very ready to adopt electric service and appliances for the many labor-doing and time-saving items. Besides running out one or two miles from towns, where a small group is favorably situated, there are three groups of farmers for whom current is stepped down by ten-kilovolt transformers from 6,600 volts or 13,200 volts and distributed at 2,200 volts and standard transformers of one-kilovolt or two-kilovolts are used for groups comprising eight to fourteen farm premises. Poles are paid for, hauled and set by the farmers who also furnish incidental assistance and meals. Their meter rate is ten cents per kilowatt-hour, with minimum of $2 per month instead of $1 as in towns. Meters are read every two months by use of automobile or horse, and collections made and small repairs and lamps supplied at same time. While the lighting of premises, ranging from 20 to 70 lamps is the first factor usually, the urgent feature with a number has been a motor-driven pump supplying water for cattle and for quite complete systems of household water supply. Motors are notably valuable for uniform operation of cream separators, and in several instances a small counter shaft in back porch or shed transmits to separator, churn, washer-wringer, mangle and pump. All have electric irons, etc. No farm motors larger than one-half horsepower are installed.

BY R. H. ABBOTT.

Mr. Abbott states in his paper that the Petersburg company was practically forced to supply energy to farmers when it decided to build a transmission line to Greenview and Mason City. Right-of-way for this line was given in exchange for the privilege of getting service. The voltage of the transmission line is 16,500, single phase, and stepped down to 2,400 volts, through transformers mounted in small houses built on twenty-five-foot poles. There are at present only two of these substations, one feeding a two-mile 2,400-volt line, supplying four customers, and one feeding a one-mile line supplying two customers. The high-tension transformers are protected by fuses only, while the individual regular distributing transformers have both arresters and fuses of the ordinary 2,400-volt type. The secondaries are all well grounded. The 2,400-volt lines are of No. 6 hard-drawn copper with twenty-five-foot poles set forty to the mile: 6,600-volt porcelain insulators are used. All of the transformers, poles, lines, arresters, etc., are owned by the customers, the company having no investment whatever. A minimum charge of $2.00 per month for customers is charged.

BY H. W. BULLOCK.

The Eureka central station operates a light and power plant at Eureka, and has high-tension transmission lines to Roanoke and Metamora, the total comprising about fifteen miles of line. These lines traverse a very rich farming community, land selling from $250 per acre up. Almost all the farmers within one mile of its transmission line have availed themselves of the opportunity to buy current and they use it for every purpose for which electricity has been used anywhere. Motors are used for all purposes, such as pumping water, grinding feed, sawing wood, elevating grain into cribs and graineries, on cream separators, churns, washing machines, sewing machines, fans, and many of them use electric irons. The company's plan is to place transformers in the most convenient place for distribution to three or more farmers if possible, and to require them to bear the expense of building the secondary lines from the transformers to their buildings. The company requires all construction and wiring to conform to the same specifications as if they were in the city, and if the work is not done by the company it must be subject to its inspection and approval. Very little trouble is experienced. The chief trouble is after thunder storms, in replacing transformer fuses. The transmission line is not as well protected as some modern lines. The refusing is often a tedious and unpleasant task.

BY J. G. LEARNED.

Mr. Learned's paper points out that the forces that are fostering the adoption of electricity for farm work make its adoption inevitable. The most economical distribution system must be obtained to handle this business to the mutual satisfaction of the central station and the customer. Those central stations which bring their service to the premises of the farmer are using cheap, although substantial, construction, a large number using iron wire instead of copper. The farmer often agrees to haul the poles and even assist in setting them. Other central stations divide the cost of the line with the farmer. Some ask the farmer to bear all the cost of the line and transformers. The central station should have definite information on successful installations in order to convince the farmer of the value of current. One center of distribution should be located on the customer's premises which will involve the least possible investment in transformers and meters. It is generally conceded that farmer business is largely "off-peak" and further that sometimes even the lighting is also "off-peak." Therefore, if enough customers can be secured it is evident that it will pay the central station for its efforts to get them. The local conditions must govern the manner in which the soliciting should be done. A list of machines used on the farm to which motors can be applied is given.

GROUP AT ILLINOIS STATE CONVENTION.

ELECTRICITY ON THE FARM.

Mr. Edwards' address was principally a plea for the consideration of the power question as applied to the farm. He said that while agricultural colleges and the United States Department of Agriculture send out bulletins and information regarding mechanical power for farm work, pointing out the advantages and economy over manual and animal power, no attempt has ever been made to study the comparative merits of the various forms of mechanical power. Mr. Edwards presented statistics showing the possibilities of electrical energy in this connection. There are over 30,000,000 horses and mules in this country and over ninety per cent are used on farms. It requires about ten horsepower-hours to turn over an acre of ground. Mr. Edwards held that the possibilities of electric power for farm work are so great that the various agricultural colleges or the government should be sufficiently interested to equip experimental farms in order to collect comprehensive data on the subject. In this connection Mr. Edwards referred to the intention of the General Electric Company to send two experts to all localities where electricity is used on the farm to secure such data as will be of benefit to central-station companies in securing this business.

These papers were discussed together. C. E. Bass opened the discussion describing an installation that had been made to accommodate farmers' business. The company maintains a sixteen-mile transmission line through prosperous farm country. A number of farmers in a particular location clubbed together and raised $200 for the transformer installation necessary to supply them with electricity. A two-mile line of iron wire was built to the transformer station where the voltage was stepped down to 2,200 volts. The main transmission line is No. 6 hard-drawn copper. No trouble has been encountered with fuses blowing during electrical storms.

H. J. Pepper of Champaign called attention to the experimental farm maintained by the University of Illinois. He said the university has an excellent electrical laboratory and will assist central-station companies in solving their problems.

H. W. Bullock spoke of a course of lectures which were given by the university and to which central-station men were invited.

Charles W. Pendell asked for information as to the length of iron-wire lines, size of wire used by companies and load on the line. O. E. Brown said that the Elmwood Company has an iron-wire line 1.5 miles in length. The wire is No. 8 size. The line was sufficient for ordinary requirements, but when a request was made for a five-horsepower motor to be installed at one end of the line it was found that a machine no larger than two horsepower could be installed.

President Austin told of using a 7.5-horsepower motor satisfactorily in connection with a similar line. The wire was of iron, No. 8, and was one mile in length. The voltage was 2,200.

E. J. Berg said that it was far more practical to use iron wire than was realized. He said that the matter of self-induction could be entirely disregarded. There would, however, be a slight loss on account of the greater resistance of iron wire, but it is entirely feasible to use it for farm work.

E. H. Negley explained that while the company with which he is connected has no "farmer lines" it does maintain an iron-wire line two miles in length which is run to a coal mine. Great trouble from lightning has been encountered, and the company is planning to string No. 6 bare copper wire along the tops of the poles for protection.

Mr. Cushing said that as the mechanical strength of iron wire is not as great as copper and as it rusts and corrodes easily it is necessary to inspect the line about every two years.

Dr. Berg said that as regards lightning disturbances, if copper wire has any advantage over iron wire it is a very slight one. The mechanical strength of copper wire is greater than that of iron. He favored flat wire for lightning protection. Dr. Berg said that the best practice now is to use the line itself, if possible, for protection. He referred to a high-tension transmission line at Kalamazoo, Mich., which is made of No. 2 B. & S. wire. This line is capable of dissipating thousands of kilowatts due to corona. The most important feature in utilizing the line itself is in using the smallest-diameter wire possible.

R. H. Abbott, referring to cost of iron-wire lines, said that the Petersburg station had constructed two miles of line for $425 per mile, not including labor. Another speaker said that two miles of line had been constructed for $200 per mile. Thirty-two poles are used for a mile of line, and the voltage is 1,100.

F. J. Baker said that it is a question how lines cheaply built will last. Great care should be taken as one accident due to cheap construction would cost the company an amount sufficient to pay the interest on a well-built line.

E. B. Hilman asked Mr. Baker why the North Shore Company refuses many requests for service from farmers. Mr. Baker replied that the company has made a practice of building lines without charge to the customers, and it would not pay to build a line in a new section until enough customers could be obtained in the vicinity to justify the investment.

E. J. Condon said that he was at present building a line for farmers' service which is costing $600 per mile. He said that the depreciation on cheap lines was so great that the more expensive line was more economical. He added that the sale of electricity to farmers would receive greater impetus if the generation at present in school could be taught some of the principles of electricity.

J. J. Frey thought that the investment necessary to provide service to farmers was so high as to make the question of profits doubtful.

O. E. Brown and C. W. Pendell spoke briefly regarding particular applications of motors to farm work.

A paper by E. MacDonald, of Lincoln, entitled "Pumping Water for City Supply" was then presented by the author. This paper, in slightly condensed form, is published elsewhere in this issue.

This paper was discussed briefly by F. J. Baker, E. J. Condon, C. W. Pendell, Charles Monroe and E. MacDonald. Mr. Baker said that if the central station could supplant electric motors with steam pumps a great stride will be made in preventing municipal electric plants. The business is so desirable from this standpoint that the company can afford to supply the service without making a profit.

Mr. Condon thought that central stations could supply energy for city pumping at an attractive rate and at the same time make a profit. He said that enough attention had not been given the method of charging on the basis of per 1,000 gallons pumped. He spoke of two towns (Harvard and Paxton) where this method of charging is in use and both municipality and company are making a profit.

Mr. Baker asked whether the city or the company maintains the machinery as this would have an important bearing on the profitableness of charging on gallons-pumped basis. Mr. Condon said that in Harvard the central station owns and maintains the motors and in Paxton, while the city maintains the equipment, the central station insists on frequent inspections and tests to determine any drop in efficiency of the machines.

C. W. Pendell spoke in favor of cen-

trifugal pumps. He describes an automatic station in which several unique features are embodied. He said that in pumping every individual installation should be studied and a pump and motor recommended best suited for the purpose.

Charles Monroe held that as the water level was constantly decreasing more expense will constantly be entailed by the central-station company in pumping if the rate is based on the gallons pumped. He advocated the kilowatt-hour rate, as did Mr. MacDonald, who closed the discussion.

WEDNESDAY AFTERNOON SESSION.

The first paper at the afternoon session was by T. W. Gregory of the East St. Louis Light & Power Company, entitled "Uniform Accounting." R. C. Hardy read the paper in the absence of the author. This was followed by the paper on "Uniform System of Accounting for Electric Light and Power Companies," by H. E. Addenbrooke of the Commonwealth Edison Company. Both papers were discussed together.

UNIFORM ACCOUNTING.

This paper points out the advantages of uniform accounting not only for making comparisons with other companies but on account of its importances should commission regulation be inaugurated in Illinois. It is stated that many companies have charged a great many items to operating expenses which are legitimate capital expenditures. This has not only deceived the management as to the actual profits but has kept the book cost of the property down to such an extent that in many cases this figure would probably be less than actual replacement cost. Reference is made to the system of uniform accounting proposed by the National Electric Light Association and it is shown that by combining some of the classifications it can be advantageously adopted by all central stations, regardless of size without additional bookkeeping expense.

BY H. E. ADDENBROOKE.

Mr. Addenbrooke referred to the classification of construction and operating accounts for electric light and power companies that was adopted by the National Electric Light Association, naming the eight main divisions of expense accounts as follows: Production, transmission, storage-battery, distribution, utilization, commercial expense, new business, and general expense. The application of these was the main subject treated in the paper. The effects derived from uniform accounting are plainly visible where serious attempts have been made to run the plant systematically and keep a full well classified account. When all is said and done, it is the balance sheet which shows the plant's real status, and if all balance sheets were uniform it would provide a starting point from which to commence an investigation as to conditions, rates, etc. All discussions concerning the regulation of public utilities have as an aim the assurance of modern adequate service at the lowest possible cost. The rights of the company must be protected.

Frank J. Baker opened the discussion urging central-station companies to adopt the uniform system of accounting as advocated by the National Electric Light Association. He asked how many companies had adopted this system since the last Illinois Convention, and upon count was shown that nine additions had been made to the list. Continuing the discussion, Mr. Baker spoke of commission regulation, which he said will inevitably come. He thought that the basis of regulation would be an appraisement and that in view of this fact, central-station companies which completely replace equipment should make it a practice to have photographs taken of the old equipment while it is still in place and file these together with accurate data relative to the installation. In reply to a question by R. S. Wallace, Mr. Baker said that while he has no assurance that a public-service commission would consider replaced equipment in making an appraisement of a plant, the investment and work necessary to keep such records as he advocated would be very small and might possibly gain recognition from the commission.

In reply to a question by Mr. Davis as to where to charge discounts on bonds, Mr. Addenbrooke said that some states allow this account to be capitalized. R. C. Hardy closed the discussion naming the states in which the discount on bonds could be capitalized and those which prohibited this practice.

This discussion was followed by a very interesting address on "Recent Progress in Electrical Engineering," by Dr. Ernst Berg of the University of Illinois.

RECENT PROGRESS IN ELECTRICAL ENGINEERING.

Dr. Berg briefly recounted the advances that had been made in electrical engineering up to 1892. From this year until 1905, great improvements were made in lighting units, the development of the flaming-arc lamps, Nernst lamps, tungsten lamps, etc., coming during this period. Since 1905, there have been no remarkable developments as regards the practical side of electrical engineering, although very wonderful progress has, according to Dr. Berg, been made in the theory of electrical engineering. Of particular importance in this connection is the exhaustive analysis of electricity that has been made by scientists during the past few years. Dr. Berg then briefly discussed the electron theory and pointed out its significance. Regarding future developments, he thought that future progress would be towards the utilization of the sun's heat for the generation of steam and electricity. This has been made possible by the development of the low-pressure turbine. Dr. Berg discussed briefly a typical thirty-horsepower plant, which is operating in one of the western states with success. From an area 500 feet square it is possible to derive 10,000 kilowatts of electrical power utilizing the rays of the sun. Dr. Berg thought that the next ten years would see a wonderful development in this field.

At this point President Austin appointed a nominating committee comprising John G. Learned, chairman, E. B. Hillman and R. H. Abbott.

The paper by Warren Partridge, of Springfield, entitled "Modern Street-Lighting Systems," was then presented by the author.

MODERN STREET-LIGHTING SYSTEMS.

This paper briefly describes the development of street lighting from the time of the introduction of incandescent lamps to the present day. Following the development of incandescent lamps came the use of small units for street lighting. In chronological order came the development and introduction of constant-current transformers, inclosed arcs, flaming-arc lamps, mercury rectifiers, tungsten lamps and ornamental posts. Of all the street-lighting systems in use today the following are termed modern systems by the author: High-power flaming-arc lamps; 6.6-ampere metallic-flame or luminous-arc lamps; four-ampere metallic-flame or luminous arc lamps; large-unit Mazda lamps; small-unit Mazda lamps; ornamental posts. The characteristics of each system are pointed out and suggestions made as to method of installation, maintenance, etc.

The discussion of this paper was very brief. R. S. Wallace thought that contracts for street lighting should be made on the candlepower basis instead of on the wattage basis. He said that this would take care of the improvements in lamps without causing either the consumer or central-station company to suffer. He described an installation of street lighting in Peoria three-quarters of a mile in length, in which single-lamp standards were employed. This installation is in the residence district, and Mr. Wallace strongly advocated this type of post for effective lighting of residence streets.

The paper by A. J. Cole, entitled "The Wire-Type Tungsten Lamp," was then presented by the author.

WIRE-TYPE TUNGSTEN LAMP.

The methods of preparing tungsten for use in incandescent lamps is described, the final processes in the two usual commercial methods consisting in either drawing out the tungsten into wire or in sintering the paste which has been passed through a die. The drawn-wire has an enormous tensile strength, but tests made upon lamp filaments both in new lamps and in those which have been burning for 400 hours show that the strength of such filaments is about the same as that of sintered filaments under the same conditions. The electrical characteristics of both kinds of filaments is approximately the same so far as their resistance and ability to withstand high temperature are concerned. The wire-type lamp is one using the tungsten filament in one continuous length, the filament being wound on supporting anchors in such a manner that it has some freedom of movement and is connected to the leading-in wires by flexible joints. The filament is wrapped around the leading-in wire in a manner to obtain the flexibility of a coiled spring. These lamps can be packed in the same manner as carbon lamps, in corrugated strawboard, with the exception that an outer layer of hay or straw is put around the exterior of the box. These

lamps have recently been used in trolley-car service and have given very satisfactory results. Tables are given comparing the performance of the wire-type lamp with that of the carbon and metallized filament lamps, and also giving figures for the cost of renewals and the cost of energy consumed in the different types under various conditions and use.

There was no discussion of this paper.

THURSDAY MORNING SESSION.

The first paper of the Thursday morning session was by F. N. Jewett, entitled "The Single-Phase Motor." This paper described in detail the new type B K unity-power-factor, single-phase motor, which the Wagner Electric Manufacturing Company of St. Louis is placing on the market. An illustrated description of this motor appeared in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for October 21 on page 853.

The discussion of this paper was very brief, Messrs. Pendell, Delaney, Thomas and Learned asking questions relative to details of design. J. H. Delaney asked Mr. Jewett if the development referred to in connection with this motor was confined to single-phase practice. Mr. Jewett replied in the affirmative. Replying to questions as to the advantages of this motor, Mr. Jewett said that while the advantages from the customer's standpoint were not sufficient over other types of single-phase motors to have him substitute the newer type, from the central-station standpoint the BK motor, being of unity power-factor, would offer many advantages over the other types.

President Austin then appointed a committee on resolutions, consisting of J. J. Frey, R. C. Hardy and C. W. King.

A paper by Charles P. Brown of Henry L. Doherty & Company, entitled "Public Policy," was then, in the absence of the author, read by F. M. Sinsabaugh.

PUBLIC POLICY.

This paper dwelt at considerable length on the attitude that should be assumed by the public-service corporation in relation to the public. The central station should consider itself the servant of the people and work harmoniously with them. The most important requisits in this connection are competent employees and a good system of operation. The paper pointed out the influence that the manager of a public-utility company can wield either for the good or evil of the company. One of the most important duties of the manager is to select employees who will be ambitious and work for the interests of the company at all times. In conclusion it was pointed out that as the volume of business increases the public-utility company should voluntarily decrease its rates as this is one of the most important considerations in gaining the good will of the public.

J. H. Delaney opened the discussion. He spoke particularly of the complaint department, and said that one of the most important requisites in handling complaints satisfactorily is patience in dealing with certain classes of customers. He recited an amusing incident in which this fact was lost sight of and upon an extended investigation it was found that the customer really had grounds for complaint.

F. H. Golding said that the policy of honesty is the best for public-utility companies to assume. In the matter of complaints the Rockford Company investigates each one thoroughly and if high bills are complained about and an investigation proves that the customer is sincere in his belief that the charge is exorbitant an adjustment is made without further litigation. Mr. Golding said that while this might seem a liberal policy no person complaining once has ever returned regarding the same matter.

H. A. FOSTER,
President-elect.

F. N. Jewett spoke of the policy of the Rochester central station in regard to newspapers. The daily papers are taken into the confidence of the central-station management and any item of news is promptly given over to the papers. Mr. Jewett said that this policy had resulted in doing much good, especially when the subjects of franchises or street-lighting contracts come before the public.

John G. Learned also spoke of co-operation with newspapers, pointing out the policy of the North Shore Electric Company in this connection.

The paper by W. A. Thomas, entitled "The Use of Electricity in Coal Mines," was then presented.

USE OF ELECTRICITY IN COAL MINES.

This paper points out the advantages of electricity for mining operations and the desirability of the business from the central-station standpoint. The application of electricity to coal cutting, coal haulage, hoisting, mine drainage and pumping and minor applications is described in detail. Several typical installations of electricity in coal mines are referred to. These installations show a load factor of from 20 to 45 per cent.

C. W. Pendell opened the discussion pointing out the desirability of securing contracts for coal mines. Service is usually required twenty-four hours a day.

J. J. Frey described an installation at a coal mine, energy for which is supplied by the Hillsboro company. A 300-kilowatt motor-generator set is employed at the mine which will soon be changed over to a 500-kilowatt set. The contract calls for service eight hours a day, from 7 a. m. to 4 p. m., this providing practically an off-peak load.

C. W. Pendell spoke briefly in favor of the rotary converter for mine service when sixty-cycle energy is available. He said that with converters a fifteen-per-cent higher all-day efficiency could be obtained than with a motor-generator set using a high-voltage motor.

The last paper presented was entitled "Motion Study in New Business," by E. W. Osborne of Rockford. This paper is presented in slightly condensed form elsewhere in this issue. There was no discussion.

The convention then went into executive session at which the report of the Nominating Committee was presented. The officers elected for the ensuing year are as follows:

President, H. A. Foster, Fairbury.

First vice-president, J. J. Frey, Hillsboro.

Second vice-president, F. H. Golding, Rockford.

Third vice-president, F. MacDonald, Lincoln.

Fourth vice-president, C. W. King.

Treasurer, F. W. Reimers, Rock Island.

Secretary, H. E. Chubbuck, Peoria.

Assistant secretary, C. A. Willoughby.

ENTERTAINMENT.

The entertainment features provided were most enjoyable. On Tuesday evening the manufacturers and supply men tendered to the delegates a smoker and entertainment which was held in the Nelson House. Informal remarks were made by the Mayor of Rockford, the President of the Board of Trade, and several central-station men and supply men. The vaudeville entertainment was provided by professional talent. On Wednesday evening the Rockford Electric Company was the host of the entire convention at a banquet also given in the Nelson House.

Central-Station Practice

ATMOSPHERIC PHENOMENA AND THEIR RELATION TO THE PRODUCTION OF OVER-VOLTAGES IN OVERHEAD ELECTRIC TRANSMISSION LINES.—I.[1]

BY G. V. ADENDORFF.

Where power is to be transmitted a considerable distance from the point of generation, the usual method of procedure is to adopt the overhead system, in which the power conductors are carried on poles or masts, and in cases where the distance of transmission is comparatively small, and where overhead wires are inapplicable, the power conductors are usually carried in the form of cables and placed underground.

In some cases of industrial and mining concerns, it is of the utmost importance that the supply should be continuous, that is to say, the risk of the supply failing should be made an irreducible minimum. Continuity of supply is an item of prime consideration, and no effort should be spared to attain such a condition of working.

Assuming that the design and construction of the system have been carried out with the view of eliminating all factors tending to produce trouble, that is to say, that the different sections of the system have been made with a reasonable factor of safety under normal conditions of working, it is obvious then that trouble can only occur either from a source external to the system, or from some internal cause created during the operation of the system. Disturbances in electric circuits then can arise in two ways: firstly, by the entrance of over-voltages from outside due to such causes as atmospheric phenomena; and, secondly, by over-voltages originating in the circuit, due to such causes as short-circuits, arcing grounds, switching, etc.

Disturbances due to atmospheric phenomena are obviously only found in overhead circuits, whilst underground cable systems are free from them, unless connected to overhead lines.

In the latter case, the disturbances generally are more pronounced and dangerous owing to the combination of the relatively large capacity of the cable system, and the high inductance of the overhead line.

Although a large amount of data has been collected on high-potential disturbances, yet such a variety of phenomena can occur that an intelligent understanding of them can only come about by thorough investigation and final comparison of the results with actual observed effects.

There is no doubt that a clear conception of the *nature* of any phenomena always tends to make the elucidation of their *effects* more exact and convincing.

It is proposed to divide this paper into three parts: firstly, to investigate the *nature* of the various varieties of atmospheric phenomena at some considerable length; secondly, from such investigations to deduce their probable *effect* on overhead lines, and finally, to point out generally the present means of protection from those effects.

The main items which come under the category of atmospheric phenomena, and which, directly or indirectly, are connected with the production of over-voltages, may be simply classified as follows: (1) Temperature effects. (2) Altitude effects. (3) Rain, snow and hail storms. (4) Wind and dust storms. (5) Atmospheric electrification. (6) Thunderstorms.

Temperature and Altitude Effects.—These may be considered together. It is found that sudden changes in temperature, such as occur at sunrise and sunset, produce static charges on conductors—the amount of static being a function of the amount and rapidity of the change in temperature. Similarly, it is also found that a conductor suspended at varying altitudes above the earth's surface receives a decided amount of static charge, depending upon the difference in level between the highest and lowest points of the conductor. As will be seen later, both these effects are probably closely connected with the phenomena of atmospheric electrification.

Rain, Snow and Hail Storms.—Rain, snow and hail are found to have a static charge, and when either moves in the vicinity of a conductor, the latter takes up a definite charge and becomes electrified.

Wind and Dust Storms.—It is easy to show experimentally that a high wind blowing across a conductor causes it to take up a definite static charge; that is to say, the conductor so exposed will be subjected to a rise in static potential, which may, under certain conditions, assume an enormous value. If the wind be accompanied by dust this effect is magnified considerably. Whether this electrification is produced by actual friction of the wind and the conductor, or by the friction of the moving particles amongst themselves, it is difficult to say, but it is very probable that a combination of these two effects operating simultaneously is sufficient to explain the phenomenon. Experience has shown that arresters on overhead lines have discharged at various points on bright, clear, windy days, which clearly indicates that the lines had been subject to some rise in potential. Further, linesmen working on dead overhead lines on windy days always encounter static on the lines, and take the precaution of earthing them before proceeding with their work.

Atmospheric Electrification.—It was first pointed out by Lemonnier in 1752 that the atmosphere was usually in a state of electrification, and more recently the subject was very fully investigated by Lord Kelvin and others. The result of their investigations shows that during fine weather the atmosphere is positively electrified—that is to say, positive with respect to the earth's surface, which is relatively negative. In fact, it has been found by direct measurement that the potential at a point in the atmosphere is always different from that of the earth and generally greater than it. This potential increases with the height above the ground, and is a very variable quantity. As a matter of fact, usually there exists a potential gradient in the air—that is, a po-

[1] Abstract of paper read at a meeting of the South African Institute of Electrical Engineers.

tential difference exists between different points in the air and ground, and between points in the air at different elevations. Lord Kelvin found this difference to be sometimes forty volts per foot, but it may be much greater or much less than this. It may reach several hundred volts per foot, and probably we may estimate as an average a natural potential gradient in the air of about 100 volts per foot.

During wet and changeable weather the potential may be negative, and its value seems to undergo greater changes than usual. This electrification, besides varying with the state of the weather, varies under normal conditions of weather, with the seasons and the hours of the day. It has been experimentally found that the electrification is greater in winter than in summer, besides being subjected to a diurnal variation. This diurnal variation seems to be associated with the hours of changing temperature, the electrification being a maximum at the time of greatest variation in temperature, and a minimum during the hours of constant temperature. It has also been found that the equipotential surfaces in the atmosphere are generally planes parallel to the earth's surface, although inequalities of the surface of the earth influence the form of the lower equipotential surfaces. The irregularities due to this cause, however, disappear at a comparatively low height. The cause of this electrification is still very doubtful. Experiments do not satisfactorily support the theory that it is due to electrical separation during the evaporation of water. This theory supposes that water vapor rising from water on the earth's surface carries a positive charge with it, leaving the water and the earth negatively electrified, but the hypothesis has not been confirmed by experiment.

It seems, however, that some variety of friction is the most probable cause of this electrification, as in Armstrong's hydroelectric machine. If the friction of water vapor and suspended particles against air be sufficient to produce electrification, then the constant falling of this matter through the upper layers of the atmosphere is sufficient to account for atmospheric electrification. Whatever the cause may be, either terrestrial or cosmic, it probably acts continuously, and during dry weather there is likely to be an accumulation, since there is no doubt that rain carries down a large proportion of the charge.

Thunderstorms.—It has already been pointed out that the whole question of the origin of atmospheric electricity and of the electrification of clouds is at the present to a large extent a matter of speculation rather than of exact knowledge. There is no doubt that the phenomena of a thnuderstorm result from the clouds being in a highly electrified state. If solids or liquids are charged, the electrification resides only on the surface, but gases and vapors, which are composed of minute particles, are capable of receiving a charge throughout their mass. The air, for instance, in which an electric machine has been worked, is afterwards found to be charged.

In the same way moisture particles floating in the upper regions of the air assume the potential of this air, and so have a definite charge given them. It is conceivable that the condensation of water vapor in positively charged air may result in a cloud of positively charged water drops. This phenomenon of the tendency to coalescence of globules floating in the presence of an electric charge will explain the formation of rain drops in a thunder cloud. Helmholtz observed that a cloud of visible steam was darkened and rendered more opaque by electrification. The dark color of a thundercloud seems to be due to the same sort of cause, and probably results from an extra amount of condensation taking place. The coalescence of particles results in a rise of potential since the radius of a resulting drop is not equal to the sum of the originals, and capacity is proportional to the radius.

Suppose eight particles unite, then the potential after is four times as great as before. The potential in this way may rise to an enormous value as will be readily seen. A potential gradient in the air is so established, and when its value reaches a definite amount the disruptive strength of the air is attained and a discharge takes place.

Lightning.—A charged cloud and the earth form the coatings of a huge condenser whose dielectric is the intervening air. If the cloud is positively charged, the earth will be inductively negatively charged, and the air will be in a state of electrostatic strain. If this stress exceeds a definite value the dielectric will give way, and a "spark discharge" will ensue. Such a discharge is called a "disruptive discharge."

We get a figure of about 5,000 million volts for a lightning flash between cloud and earth one mile in length.

(To be continued.)

Utilizing Waste Coal for Firing Steam Boilers.

An illustration of the feasibility of using waste coal for power purposes has recently been given in Hull, England, one of a new type of patent water-tube boilers having been installed in a mill in that city. The success of the public exhibition given shows, it is claimed, that much coal which has heretofore been rejected as worthless can be used, and that greater efficiency can be obtained from this waste coal by the new method than from the best coal by the old method.

The system employs the known principle that almost perfect combustion can be obtained by mixing air in proper quantities with pulverized coal before the latter is introduced into a furnace. This insures better combustion with less air than usual, and with a consequent increase of boiler efficiency by reducing the amount of heat carried away by the escaping gases. The results obtained with the poorest kind of fuel are claimed to be as follows:

(*a*) The almost total elimination of losses, as all the fuel is burned in suspension, the amount of unconsumed coal in the furnace at any given time being infinitesimal.

(*b*) The rapidity with which steam is raised under ordinary conditions. The system differs from others in that with ordinary furnaces some time is taken before the fires are completely alight, but in this case as soon as the boiler is fired theoretically full effect is obtained.

(*c*) The smallest and cheapest kinds of "slack" are burned with ease, and high efficiencies are obtained

(*d*) The arrangements permit a close inspection of the straight vertical tubes.

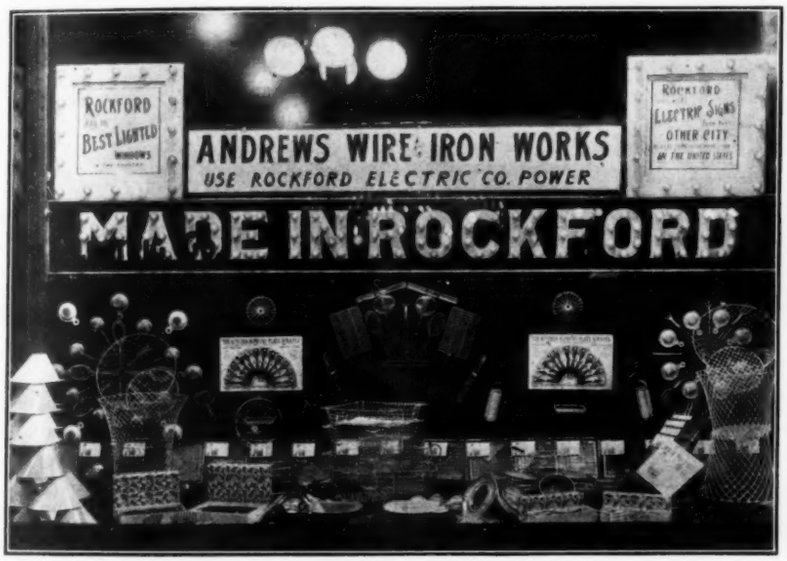
(*e*) The reduction of supervision necessary.

Coal dust costing $1.25 a ton, which could not be utilized in any other way, was burned under this boiler and gave equal efficiency as compared with coal costing $2.50 a ton and used with the old style of boiler. The boiler can be placed in operation and taken out of service by holding the fire up in one minute. In twenty-six minutes a steam pressure of 180 pounds can be obtained, whereas it takes about four hours to fire a boiler of the old style. At mealtimes the fire can be cut off and a great saving of coal effected.

Commercial Practice—Management, Rates, New Business.

Utilizing Show Window to Good Advantage.

An ingenious scheme for utilizing its show window has been inaugurated by the Rockford Electric Company, Rockford, Ill., with excellent results. The scheme is to invite the various manufacturers of Rockford, using central-station service, to display their goods in the company's show window, each manufacturer being allowed the use of the window for a period of one week. Appropriate signs calling attention to the display are shown, the electric company providing a permanent electric sign reading "Made in Rockford by Electric Power." It is instantly apparent that this provides effective advertising both for the central station and for the manufacturer. In fact, Manager Golding of the Electric Company states that it has been definitely proven that a number of people make it a point to pass the window each week to see the new display.



ROCKFORD ELECTRIC COMPANY'S WINDOW UTILIZED BY CUSTOMER.

The scheme has also been found effective with prospective customers, several of them having been invited to utilize the window at different times. The accompanying illustration shows the appearance of the window during the week of October 23.

In Berlin, the capital of Germany, there are 176 electric lamps of sixteen-candlepower, or its equivalent, for each 1,000 inhabitants.

MOTION STUDY IN NEW BUSINESS.[1]

BY E. W. OSBORN.

Nearly everybody in the past few months has been very much interested in the development of a new science commonly known as "Motion Study." At first it was regarded as a fad, but after it had been thoroughly demonstrated what could be accomplished by its application, manufacturers in all lines of business commenced to take it up and were generally enabled to increase their output, thereby lowering the manufacturing cost per unit, and also to increase employees' wages.

By the elimination of useless motions in all forms of labor, from two to three times as much work has been accomplished by the same men and with less expenditures of energy on the part of the men themselves than with the old methods.

In the electrical business the little we have heard of motion study has been in the operating end, and it may seem strange to some of you to think of applying it to a new-business department. As far as we know there has never been an analysis made of a new-business department by a motion-study expert, but the good results that have come from it in other departments would make it seem that some of the same methods could be successfully employed in this end of the business.

Among solicitors there is a great deal of time unconsciously wasted, which if properly used would bring in a large amount of additional business.

A solicitor should systematize his work so that he eliminates all waste of time, and so lay out his work that never, at any time of the day, would he be wondering whom he should call on next. To do this, he must be at the office at 8 o'clock and by going over his reports and call slips pick out enough good prospects for the day. Being in the field at 9 o'clock and making every minute of that time up to 5 o'clock count will bring any salesman success.

Many solicitors after securing a contract pay no further attention to the customer. This is all wrong, as a customer who has been well solicited before closing a contract soon notices the lack of attention after he has once become a customer.

The best kind of business will in time be lost unless frequent calls are made to ascertain if everything is perfectly satisfactory, as most customers hate to complain about small things, but, if frequently called on, many little or fancied grievances can be smoothed out which, if allowed to run on, would probably mean an ultimate loss of business.

Right here is where the odd minutes which a solicitor often has on his hands can be spent most profitably for the company, and any solicitor who loses sight of old business in the search for new will soon find he has no well satisfied users to refer to.

Many profitable minutes can be spent outside of soliciting hours in looking over the meter record sheets each month and in this way know exactly what each customer in his territory is consuming. In this way, high bills can be investigated in advance of the customer's receipt of them, and if a complaint is filed, the solicitor can produce immediately data which should account for the increased current consumption.

Many solicitors make the fatal mistake of staying away from a customer when his bills are high or his service poor on account of disliking to hear complaints, hoping that time will wipe out the trouble.

1 Paper read before Illinois Electric Association convention at Rockford, October 26, 1911.

Remember that holding old business is a part of a solicitor's work as much as securing new business, and by shirking a task simply because it may seem disagreeable will certainly cause inestimable damage to your company.

In securing data for a customer, such as comparisons of previous bills, or on some particular device, never give it to him in a slip-shod manner on scraps of paper, but have it compiled after soliciting hours and neatly typewritten as the additional interest and respect which he shows you will then repay you for the trouble.

After the day's work is a good time to analyze each interview carefully to discover what made your calls a success or failure, as by so doing, all weak and useless arguments can be eliminated.

At the present time central stations are considered as having the most progressive sales departments in the world and certain it is unless we take advantage of some of the ideas and methods of motion study, other lines of business will take it up and our boasted progress and supremacy will be but a memory.

Two Good Books for Stimulating the Use of Electrical Energy and Equipment.

One of the most satisfactory evidences of the advantages of co-operation in the electrical industry for the stimulation of interest in the utilization of electrical energy and equipment is found in the campaign which the Commercial Section of the National Electric Light Association is now carrying on. Through its various committees the Commercial Section is placing in the hands of the ultimate consumer just that information which is required to make evident the advantages of electrical utilities. In two instances where this work has taken tangible form, the success has been beyond the expectations of the most sanguine of its promoters.

Through the co-operation of the National Electrical Contractors' Association, the National Electric Lamp Association, the Electrical Supply Jobbers' Association of the United States, and the National Electric Light Association, a booklet entitled "The Electrical Equipment of the Home" has been prepared for distribution to architects, builders, contractors, central-station representatives, and residence and industrial prospects. This book has been prepared by the Wiring Committee of the Commercial Section of the National Electric Light Association.

Another very important book is entitled "Data on Electric Signs." This book has been prepared by the Sign Committee of the Commercial Section of the National Electric Light Association.

THE ELECTRICAL EQUIPMENT OF THE HOME.

"The Electrical Equipment of the Home" is designed to show the necessity of equipping residences for more complete electric service than has been customary heretofore. It shows the possibilities of electrical service and outlines the principles of residence equipment and the considerations which must be undertaken in laying out wiring plans. It assumes a typical residence and discusses the equipment features of each room individually. It outlines the fundamentals of practical illuminating engineering in simple form giving simple data for the calculation of illumination intensities, the values and service of various types of reflectors, the relation of wall coverings and hangings to various forms of illumination, and discusses the mechanical and electrical features of lamps, fixtures, and reflectors suitable for residence service. There is also a section on heating appliances, power appliances and fittings, giving the energy consumption and the cost of operation of ordinary apparatus and appliances used in the home. Under electric power appliances there are considerable data on the useful equipment that is now available for motor drive. A concise chapter on planning the wiring, with a series of diagrams, showing the method of running the circuits and indicating the placing of the outlets, gives a number of very practical suggestions.

DATA ON ELECTRIC SIGNS.

"Data on Electric Signs" is designed to give the non-technical employees of the central stations who may be engaged in selling current for electrical advertising, the fundamental facts upon which good practice is based. In all cases the recommendations are designed with a view to giving the best results regardless of the selfish interests of the central station, the sign manufacturer, the lamp manufacturer, or the customer. The book deals first with general considerations of the advantages of electric signs, makes suggestions for comparing the relative values of signs of different characteristics, the cost, the location, the daylight appearance, the use of color and the lamps and wiring required. The book is replete with up-to-date information, and is certainly worthy of the close study of everyone interested in this development.

These books are being distributed through the agency of the central stations, electrical contractors, electrical supplymen, and through the manufacturers of the electrical material involved. "Data on Electric Signs" has already had a distribution of some 15,000 copies and "The Electrical Equipment of the Home" is well under way for a distribution of 50,000 copies. Through the contributions of the National Electrical Contractors' Association, the Electrical Supply Jobbers' Association of the United States, the National Electric Lamp Association, and the Commercial Section of the National Electric Light Association, the first cost of these publications has been covered and they are now available for further distribution at a nominal price. The distribution is under the direct supervision of Philip S. Dodd, secretary of the Commercial Section of the National Electric Light Association, with headquarters at 1818 East Forty-fifth Street, Cleveland, O.

Lighting Rates at Long Beach, Cal.

The City Council of Long Beach, Cal., is preparing to draft an ordinance reducing the lighting rate from ten cents to eight cents per kilowatt-hour, and the gas rate from $1.15 to $1 per thousand cubic feet, upon the initiative petition presented by the Progressive League, composed of inhabitants of the city. An additional ordinance is also planned regulating the quality of gas, and the voltage, etc., of electric energy to be supplied.

The companies affected, the Southern California Edison Company and the Consolidated Gas Company, both having the same officials, filed communications with the Council offering to reduce the lighting rate to nine cents on January 1, 1912, and to eight cents in July, 1913 and to establish a gas rate of $1.00 on July 1, 1912. Both offers were refused. The companies, it is said, will protest against the rates about to be fixed, in protection of their respective properties.

Electric Lighting and Illuminating Engineering

IRON AND STEELWORKS ILLUMINATION.[1]

BY C. J. MUNDO.

It is a curious fact that while one of the first practical applications of electricity in steel mills was for illumination purposes, advance along engineering lines in this branch of the application has proceeded comparatively slowly. This is doubtless due largely to the important power problems which have engaged the engineer's attention, but partly to the limited flexibility offered by the older types of lamp, and partly to the comparatively recent application of engineering principles to the important and far reaching problem of iron and steelworks illumination.

In view of the present-day abundance of commercial electric illuminants suitable for this service, which in general represent improvements in length of life and efficiency, possess a variety of peculiar advantages, and offer a flexible range of candlepower sizes, it is believed that a description of accepted methods of arriving at illumination results, a discussion of the points bearing on the satisfactoriness of the results, a general discussion of the most advantageous applications of lamps, and the factors to be considered when making a choice of lamps for the future illumination of the plant, will be of interest to the operating engineer.

A brief preliminary word in regard to illuminants in general. The 9.6-ampere 50-volt series arc lamp, operated on Brush arc machines, is still used in several places, largely because of the satisfactory operation of the Brush arc generators. Series circuits, are, however, being confined to out-of-door service for safety considerations and this type of lamp will doubtless soon disappear from the field of inside lighting. In three plants the open arc is slowly being replaced by a 9.6-ampere series arc of the luminous type. While more efficient than the inclosed lamp the open arc has a short life and requires daily electrode renewals. This, in addition to the fact that its light is somewhat unsteady and not most advantageously distributed, led to the general adoption of the less efficient but more satisfactory inclosed arc.

The most widely used lamp today in iron and steelworks is the standard inclosed carbon arc of the 5-ampere, 125-volt, or 2.5-ampere, 250-volt types. For many years past, lighting requirements have been settled occasionally by the use of the series open arc, or clusters of carbon incandescent lamps, but very generally by the selection of the favorite brand of inclosed arc as a satisfactory panacea for all lighting evils from the illumination of the interior of an iron ladle during the process of rebricking to that of the open-hearth casting floor from above the craneway. This type of lamp has given very good service. Its low efficiency, however (see Table 1) accounts for its gradual replacement by the more modern lamps.

The advent several years ago of the short-life flame arc aroused the operating engineer to the savings in current consumption and generator capacity possible by the use of this unit in place of two or several inclosed arcs.

TABLE 1.

Lamp and Equipment.	Initial Downward Lumens per Watt.	Per Cent
Direct-current inclosed carbon arc lamp, 2.5 amperes, 250 volts. Clear inner globe and reflector..	1.95	46
Ten 16-candlepower carbon incandescent lamps under flat white 26-in. reflector	2.15	50
Direct-current inclosed carbon arc lamp, 5 amperes. Clear inner globe and reflector.....	4.28	100
Direct-current open carbon arc lamp. Series, 9.6 amperes. Clear globes, no reflectors.....	9.63	225
Mazda with reflector (clear). Average of 100-500 watt sizes at medium operating efficiency....	6.00	140
Direct-current multiple luminous arc lamp, 4 amperes. Clear globe, streeet reflector.....	6.74	150
Direct-current multiple luminous arc lamp, 6.5 amperes. Clear globe, deep internal reflector...	9.48	222
Direct-current converging carbon flame arc, 12 amperes, 17 hours. Opal globe	15.80	369
Direct-current multiple long-burning flame arc, 6.5 amperes. Clear globes	17.05	398

The question of the fitness of this high-candlepower lamp in many of the applications for which it was employed was not always thoroughly entered into, many of the lamps being used for lighting low or comparatively confined areas where the use of a high-candlepower lamp was wasteful of light, and when its use often defeated the purpose of good illumination. Nevertheless some of the lamps found their best applications in the lighting of large, high buildings and shipping yards where their huge downward directed volume of light was well utilized, and where, therefore, the use of this lamp, inherently costly to maintain, really resulted in economical lighting because of the large area lighted.

This type of lamp in its brief existence had passed through the history of the open and inclosed carbon arcs. The arc has been inclosed to restrict oxidization, the carbons increased in volume and placed vertically instead of inclined, and the lamp is now available in the long-burning type.

The advent of the metallic-filament incandescent lamp in the larger sizes and in still higher candlepower groups, of the luminous, mercury-vapor, and long-burning flame arcs make the selection of lamps which will best meet the diverse conditions of the large plant a puzzling one. The engineer faces the desire of producing satisfactory results with due reference to economy—yet his troubles are reduced by standardization and simplification. It is proposed to discuss in this paper the selection of types and sizes of lamps and to make an attempt to show that a selection of lamps by candlepower sizes goes hand in hand with economy and is as necessary for best illumination results and economy as a selection of motor horsepowers for power purposes.

It will be noted that the data in Table 1 have to do merely with the efficiencies of lamps and must not be considered as a final comparison since the efficiency is merely one factor to be considered. Moreover the comparison is on the basis of initial candlepower and lamps are known to depre-

[1] Abstract of a paper read at the convention of the Association of Iron and Steel Electrical Engineers, New York City, September 29, and at a meeting of the Pittsburgh Section of the American Institute of Electrical Engineers, October 16.

ciate differently in service. The table is submitted, however, to give, in an approximate way, an idea of the possibilities with the new lamps in respect (1) to possible release of generator capacity where the present lighting is satisfactory, or (2) to the raising of the present illumination standards without increase of generator capacity. The data are based on 125 volts since the 250-volt direct-current circuit is most usually met with in iron and steelworks.

PREDETERMINATION OF ILLUMINATION RESULTS.

To predetermine illumination results two principal methods have for some time been used in engineering practice. For the present at least the two methods doubtless should be used in conjunction in view of the absence of complete data applying to iron and steelworks. Since wall reflection in the average building found in such plants can safely be neglected the calculation of complete data for different buildings, heights and widths will be a fertile field for future cultivation by lamp manufacturers in order that the simpler flux method of calculating results can be employed by the busy operating engineer. Such data can be obtained also by tests with portable instruments made for this purpose.

The flux-of-light method has the limitation that except when accompanied by rules for height and spacing it affords no guide to the uniformity of intensity at various points over the area illuminated, hence the desirability of employing the point-by-point method in conjunction with it, to insure that the intensity is not excessive or too low at any point, that it does not vary too greatly at points short distances apart and especially to insure that no bad shadows occur.

The point-by-point method, based on the use of illumination curves, is a very simple and useful although somewhat laborious method of determining the height, position and candlepower size of lamps for a given desired result.

A small amount of experience with the point-by-point method and the illumination curve will make the user familiar with the following facts:

(1) In general as lamps are hung higher for a given spacing the illumination becomes smoother and the overlapping illumination from adjacent lamps becomes effective in higher proportion at any given point. For this and other reasons lamps should be hung reasonably high.

(2) Advantageously to utilize the illumination from the high-candlepower lamps they should be hung high, since this makes the illumination results more uniform and spreads the light over a larger area. High-candlepower lamps cost relatively high to operate and their economical employment necessitates lighting large areas per unit. Conversely in high and wide areas economical results may in general be obtained by the use of high-candlepower lamps. It follows that in low or confined areas the illumination from high-candlepower lamps may be prohibitively wasteful of light and more economical results may be obtained by using low-cost, low-candlepower lamps.

(3) The average intensity delivered on the working plane by lamps hung at a given height is dependent on the candlepower intensity or size of lamp, the candlepower distribution and the number of lamps. It seems strange to have to argue that an open-hearth building can be lighted from over the cranes with sixteen-candlepower lamps if one desired, but such is the fact, it being only necessary to multiply the number of lamps until the results are obtained. It must be kept in mind, however, that this lighting would be expensive. Nevertheless lighting of this kind is done in many armories on occasions when decorative lighting is in order.

Paragraphs (1) and (2) have to do with the most advantageous use of lamps with respect to satisfactoriness of delivered illumination and economical results.

Paragraph (3) shows that illumination intensity may be varied at will by varying the number of lamps employed, or for a constant number of lamps by varying the size of the lamp. This control of the intensity delivered is desirable since (Table 2) the intensity requirements in the various buildings of the works are quite different. For example the open-hearth building requires only 0.20 foot-candle; while the machine shop requires from 1 to 2 foot-candles.

Because of the necessity of lighting economically both large and confined areas, high and low studded buildings, and because of the diverse intensity requirements, it will be seen that a choice of a range of candlepower sizes in lamps is a logical and advantageous thing for the future illumination of the works.

In the practical mill-lighting problem the height of lamps and often the spacing is dictated by the construction of the building. It is advisable in calculating the illumination to lay out a floor plan of the building which can easily be scaled. Position of machines should be shown on such a plan in order that shadow effect may be predetermined. To ascertain the service illumination the average obtained from the resultant curve should be multiplied by the factor which allows for depreciation. In the absence of data for using the flux-of-light method in conjunction with the point-by-point method the latter must be employed alone, a number of lamps being chosen arbitrarily or on the following rough basis: Lamps should be spaced on such centers with due reference to roof trusses and other practical conditions that the added illumination from each at a point midway between outlets is equal to the desired intensity. Illumination from other lamps may chance to compensate for the allowance required for depreciation. If not the process should be repeated until satisfactory results are obtained.

SATISFACTORINESS OF ILLUMINATION RESULTS.

It is suggested, to begin with, that illumination is a result and bears the relation to lamps that a result bears to a cause. Objects are visible because of the light which they reflect or by contrast between the light which they reflect and that reflected by surrounding objects. The results produced on the working plane is what concerns the man who does the work. A lamp may throw any quantity of light on the working plane and the resulting illumination be unsatisfactory. The illumination may be too high or too low, although within certain fairly wide limits the eye can accommodate itself to a range of intensities. It may be too high in a given spot and too low at an adjacent spot, the latter seeming much worse off by the contrast. There may be serious shadows. The lamp by its position may make otherwise satisfactory illumination entirely inadequate.

One of the difficulties to meet in furnishing good illumination will be to overcome the ideas of some workmen on this subject. A common prejudice among workmen in favor of a "big

light" is a result of a mistaken conception of illumination since a sixteen-candlepower lamp by being wrongly placed may defeat the purposes of illumination. The big light is useful in its application but may be harmful physiologically and costly when not employed in that application.

In order to insure the general satisfactoriness of illumination results the following considerations are suggested as to give weight when laying out the lighting plan.

(1) Intensity.

(2) Freedom from shadows where these are objectionable.

(3) Freedom from excessive glare.

INTENSITY.

(*a*) *Sufficient Intensity.*—Intensity requirements in many of the buildings in iron and steelworks are unique as compared with those in other industrial plants, inasmuch as many of the processes can be carried on entirely or for the most part by the light afforded by the metal itself and the artificial illumination then requires to be such that workmen can find tools, inspect and make repairs to machinery and be safe from accident when there is no hot metal to give light. For example, the open-hearth and Bessemer soaking pits, except for the valve building, in many works are not illuminated since no continuous work is carried on over the pits. When ingots are extracted from the pits ample light is afforded the cranemen by the hot metal when the pit lid is removed. The safety committees are requiring, however, that some light be placed in the soaking-pit building as a safeguard.

The question of economical and satisfactory intensities for the various yards and buildings of iron and steelworks has been the subject of considerable investigation, and numerous tests made for one of the large manufacturers during the last year resulted in the adoption of values shown in Table 2. These values are understood to be in terms of the intensity received on the horizontal working plane with the exception of pathway and general yard lighting where the intensity is taken as on a plane normal to the ray from the lamp.

It must be remembered that sufficiency of intensity is only one of the factors having to do with the satisfactoriness of illumination and the intensities given here presuppose correct condi-

TABLE 2.

Service	Intensity Recommended Foot-Candles	Remarks and Requirements
General office illumination.	3 to 6	For continued clerical work, it is essential that lamps be distributed so that each man obtain as good illumination as the next without shadows; light should be carefully diffused by using bowl-frosted lamps and using diffusing reflectors, otherwise eye strain and consequent complaint may result. Distributed illumination from ceiling units eliminating desk lamps is recommended as a clean cut and satisfactory method.
Drafting offices.	4 to 8	To see 6 H pencil line on duplex paper; to see line required to be traced. For drafting rooms very high intensities are required and it becomes economy to concentrate this light on the table by means of the bow-frosted drop light with a reflector having a diffusing surface. Comparatively low general illumination from ceiling units is recommended in conjunction with the local table lighting.
In machine shops at tools and vises.	3 to 5	Man must watch chip taken off by cutting tool and the finish left by same. At vises to work to dimensions. It is suggested that tool and bench lights be equipped with metal reflectors. If this reflector does nothing else it keeps the glare of the lamp out of the workman's eyes, lessening fatigue.
Mill warehouses where shipping is not active. Mill loading yards where there is no inspection.	0.15 to 0.25	For cranemen to see workmen and piles and shapes of material. It is required to see marking on material.
Open-hearth charging floors. Soaking pits.		Cranemen should be able to distinguish workmen and the latter should be able to make out the movement of charging cars and crane.
Open-hearth cast houses.		Cranemen must see to pick up ladles and cinder or slag vessels; workmen require to break up and load slag and to see movements of crane.
Skull cracker yards. Mold yards.		
Ore yards.		Ore yards can conveniently be lighted from the travelling ore bridges by means of high-candlepower lamps with intensive light distribution.
Loading yards where inspection is done.	0.30 to 0.50	To see flaws in surface when inspecting metal.
Blast furnace.	0.30 to 0.50	To see tools on floor. To watch water system from floor; to see tuyer mechanism.
Cast houses.		To repair runways after metal has been poured.
Ladle house. Boiler house. Mixing house.		Good illumination is apt to lead to cleanliness about the boiler house.
Machine and roll shops.	1.00 to 2.00	The labor employed is in general of high class and men should be given cheerful surroundings and good illumination for the best results. Where machine tools are spread over large areas, light should be distributed since one man needs as much light as another, to read blue prints. Safety in the operation of dangerous machinery must be considered. A man working at a tool or bench requires much higher intensities (3 to 5 foot-candles) on the work. A drop light equipped with a good reflector to concentrate the light and to take the glare out of a man's eye, is flexible and necessary to see inside of castings. It has been found practically impossible to do away with this auxiliary in most cases, and its use really results in economy since without the drop light the general illumination would have to be from 3 to 5 foot-candles.
Carpenter shops.		Same is true.
Wire-drawing mills. Threading floors of pipe mills.		
Power houses.		To see that machinery is working properly, that oil is feeding and to make repairs in case of accident.
Foundries.		For mold making. It is required to see by contrast in the illumination the meeting of surfaces in different planes, the finish of such surfaces, etc.
Transfer and storage bays of above shops. Pipe testing and inspection. Galvanizing shops. Cold rolling mills.	0.50 to 1.0	In machine and similar shops, high bays are used to a certain extent for storage and the transfer of raw and finished material by means of the crane. It is possible to differentiate between the illumination employed in such bays and that used when workmen require to read prints.
Path illumination.	0.015 minimum normal foot-candle	To detect obstacles or inequalities in the road. To make out forms and faces, to read a watch or make out fine print. If the minimum be taken as the illumination on a plane normal to the ray from the lamp and four feet from the ground, it is believed that the requirements with respect to the road surface will be taken care of.
General yard illumination.	0.015 minimum normal foot-candle	To see ties and tracks, to detect a presence in the yard. The best illuminated yard is that with the lowest maximum and the highest minimum. Therefore, when high-candlepower lamps are employed they should be hung high. The efficiency of the illumination is, of course, determined by the minimum.

tions with respect to shadows and glare.

(*b*) *Uniformity of Intensity.*—For the best results the illumination intensity delivered on the working plane should be as uniform as possible or else should vary by such degrees that the eye when required to perform its regular functions under the illumination can adjust itself naturally and without strain to the different degrees of intensity. While it is difficult to give figures for guidance in this matter a few general points can be taken up, due respect for which should prevent harmful variation in an installation. Diversity coefficients, i. e., ratios of maximum to minimum illumination, are employed in general engineering practice, particularly abroad, by which to compare the excellence of results in this respect.

When a high-candlepower lamp is hung low, an unnecessarily high intensity of light may be cast on the working plane and this intensity falls off comparatively fast as the distance from under the lamp increases. Obviously a waste of light occurs under such a condition; moreover the illumination is not satisfactory. A workman having spent several moments at point *A* in passing to point *B* experiences the following: Due to the high intensity at point *A* his iris has contracted to protect the retina as far as it can from over-stimulation and consequent fatigue. As the workman passes out of the high-intensity illumination the iris opens to admit a sufficient quantity of light to the retina so that a clear image may be formed of objects in his way. The eye may take some time to adjust itself to the conditions, during which the workman may stumble over an obstruction. It may be that the illumination at the point where the accident took place would ordinarily have served the purpose of permitting the workman to find his way out. The contrast between the high and the otherwise sufficient low illumination intensities render the latter entirely inadequate. Conversely in passing from the area of relatively low illumination to that of excessive illumination, the eye protects itself by shutting out the excess of light. No immediate physical harm may result from such illumination, but a time lag exists which has a general effect on the workman's efficiency.

In general, intensity of a desirable uniformity can be secured by spacing and choice of candlepower size for a given height of hanging.

FREEDOM FROM SHADOWS.

Shadow is not to be condemned as an unmitigated evil. Shadows have their usefulness since the eye depends on shadows or contrasts to bring out the contour or details of an object. They may be objectionable, however, depending on their density and position. In a general way serious shadows lower the efficiency of illumination. Shadows may be controlled to a large extent by the location and multiplication of outlets. In many buildings objectionable shadows hardly ever occur as on the charging floor of an open-hearth building which, if high studded, could well and economically be lighted by high-candlepower lamps. In a tank or locomotive erecting shop, however, bad shadows may result unless outlets are spaced fairly closely. It is obviously more economical to multiply low-cost low-candlepower units than high-cost high-candlepower units to obtain the desired freedom from shadows.

FREEDOM FROM EXCESSIVE GLARE.

Glare is defined as a dazzling light. The result of glare is to cause rapid eye fatigue and irritation. If subjected continuously to the sensation of glare the eyesight cannot fail to be impaired. Presence of serious glare lowers the general efficiency of a lighting system.

Glare is met with under the following conditions in iron and steelworks illumination.

(1) Too great contrasts between intensities on the work and elsewhere.

(2) Too rapid variations in intensity. This is met with when high-candlepower lamps are hung too low. The remedy is obvious.

(3) A brilliant source of light in the line of sight, whether a lamp or a reflection.

Glare may be obviated by hanging brilliant lamps high, by the use of diffusing glassware or shades, by efforts toward evenness of illumination and reduction of shadows.

MOST ADVANTAGEOUS APPLICATION OF NEW LAMPS.

Incandescent Lamp.—The incandescent lamp is available for service on alternating or direct current in sizes suitable for desk, table or machine-tool lighting, up to single sizes or groups for the illumination of high studded shops. The illumination of low and medium studded areas indoors and confined areas out of doors is economically accomplished with the various candlepower sizes of metallic-filament lamps provided with good porcelain-enameled steel reflectors. Moreover in high studded shops where objectionable shadows may be cast by using high-candlepower lamps on large spacing distances it is economy to multiply low-candlepower incandescent units, which have proportionally low costs, until the desired intensity and distribution are secured, rather than multiply the number of high-candlepower units. The 250, 400 and 500-watt metallic-filament lamps employed for high lighting of this kind give very good results although the cost may be somewhat higher than if the same area were lighted with high-candlepower, high-efficiency arc lamps. The light from the metal lamp is steady and clean cut in color, and the lamp is found to be living well up to the manufacturer's life claims, under the comparatively rough service. The lamp takes no appreciable excess current when thrown on the circuit, and no subdivision of lighting circuits is necessary on this account. Its candlepower varies with the voltage, and if the lamp be chosen with due reference to the highest voltage liable to be impressed it will stand almost any decrease in voltage and still give some light. The lamps and reflectors while requiring comparatively little attention in a clean shop should, when employed in shops the atmosphere of which is dusty, be cleaned regularly to secure the best results. This is true of any lamp. If a lighting system is worth installing it is worth keeping clean and tests show that it is decidedly profitable to clean all types of lamp regularly, even in office service. In offices, drafting rooms and clean shops bowl-frosted lamps should be used; otherwise clear lamps, since a roughened surface tends to facilitate the gathering of dust and dirt.

The comparatively infrequent renewals of lamps during the night can be taken care of by motor inspectors. The least skilled labor can be employed for maintaining incandescent lamps inasmuch as they require no repairs and their renewal involves the single process of screwing in a new bulb.

Incandescent lamps can be selected closely for the conditions of service be-

cause of the three-operating-efficiency rating. If the voltage of the lighting circuit in a mill be 120, lamps purchased with 120-118-116 labels are rated to burn 1,000 hours; when so burned they are said to operate on high efficiency. If purchased with 122-120-118 labels they are rated to burn 1,300 hours and are said to operate on medium efficiency. When purchased with 124-122-20 labels they are rated to burn 1,700 hours and said to operate on low efficiency. The spherical candlepowers at the several efficiencies are in the ratio 100.0, 92.8 and 86.4, and the watts consumed will be in the ratio 100.0, 96.8 and 94. The wattage rating of the incandescent lamp is therefore only nominal.

Since the life increases 30 and 70 per cent and the wattage decreases 3.2 and 6 per cent, respectively, as the lamp is operated on the low efficiencies the renewal cost and the current cost also decrease. But for the same illumination results more lamps must be used than when lamps are operated on high efficiency. The additional number of lamps over the number estimated by the use of high efficiency data is shown in Table 3.

The following table shows relative costs for the same illumination of operating 250-watt tungsten lamps at each of the three efficiencies recommended by the manufacturers. The marked difference in costs will be noted in the case where fixed charges are neglected. When these charges are included a difference exists in favor of the lower efficiencies, but the costs are so nearly the same that the Electrical Committee of the Carnegie Steel Company has standardized the medium efficiency for tungsten lamps in the Carnegie steel plants. This conclusion was also based on the facts, first, that it is practically necessary in order to minimize the variety of lamps to purchase for the average condition in the plant, and, secondly, that in a number of plants an average life of 1,300 hours is being secured.

TABLE 3.

Per Cent Lamps Required for the Same Illumination.

Lamp Wattage.	Operating Efficiency.		
	High.	Medium.	Low.
100 to 500 inclusive	100	107.5	115.4

These facts finally result for the same delivered illumination in a compromise between the current and lamp-renewal cost whereby a large amount of inexpensive current is used and lower lamp-renewal costs are obtained. Current costs in iron and steelworks range between $0.0033 and $0.0050 per kilowatt-hour exclusive of fixed charges. Now, on the above basis (not considering the fixed charges) the low operating efficiency shows up favorably and appears to be the most advantageous efficiency. It should be kept in mind, however, that as the use of current—however economically generated—increases, the cost of apparatus to supply and control it increases.

TABLE 4.

Operating Costs for Equal Illumination of 250-watt Mazda Lamp (4,000 hours service. Current $0.005 per kw-hr.)

Operating efficiency.	Low.	Medium.	High.
Current and maintenance costs only	$14.01	$13.25	$12.57
Cost including fixed charges on apparatus, lines and station.....	$22.22	$21.98	$21.75

Most candlepower distribution curves for incandescent lamps are made with lamps on high operating efficiency. This fact should be taken into account when employing the flux-of-light or the point-by-point methods.

In passing it is pointed out that the incandescent lamp is continually improving in quality, but at the same time undergoing a gradual reduction in price. It is a familiar fact that the latest improvement in the lamp consists of the substitution of the drawn-wire filament for the pressed filament, the result being much lower breakage in shipment and better performance in service. Even after having burned some time the drawn-wire filament is several times stronger than the pressed filament.

Arc Lamps.—The various types of arc lamps represent improvement in efficiency, in life and ultimate economy when employed for lighting large areas where the lamps can be hung high. Lamps hung above the craneway should be equipped with reflectors suitable for an economical direction of the light to the floor since wall reflection cannot be depended on to aid in this. Lamps so hung are trimmed from the crane which is provided with a switch cut-out opened by the trimmer before he gets upon the trolley to get at the lamp, from walks laid over the lowest chord of the roof truss, or by being hung on an absolute cut-out and lowered to the ground for attention.

As stated, the short-life flame lamp has been followed by the long-burning vertical-carbon flame lamp. The lamp with which the speaker is most familiar is suitable for use singly on 110 volts alternating or direct current, two or more in series on direct-current power circuits and on series alternating-current circuits. One electrode is renewed at each trimming and the electrode on multiple circuits lasts from 100 to 120 hours. The fumes from the homogeneous electrodes are circulated through the condensing chamber above the globe where they are cooled, condensed, and deposited, thus keeping the inner globe clean.

The luminous type of arc is made only for direct-current service. It is available for multiple circuits in 4 and 6.5-ampere sizes. The series lamp is made for alternating-current service of standard frequencies with the rectifier set in 4, 6.6 and 9.6-ampere sizes. The characteristic feature of the lamp consists of the electrode of which the lower is a magnetite composite in a steel sheathing and the upper a solid copper block. The lamp design and construction is also especially rugged. The lower electrodes have a life of 175-200, 100-130 and 80-90 hours, respectively, for the several sizes, and the upper electrodes have a life of from 6,000-8,000, 1,000-2,000 and 400-500 hours, respectively.

Both the flame and luminous arcs discussed are of the focusing types; i.e., due to the fact that the electrodes are fed to the arc, the latter remains at the same point with respect to the reflector, so that the candlepower distribution throughout the life of the lamp is not made to vary because of a change in arc position.

CHOICE OF LAMPS.

The varied illumination requirements of the iron and steel plant present areas large and confined, high and low studded, places where shadows are objectionable and places where they are not. As a general proposition it has been shown that it is economical to use low-candlepower low-cost lamps in confined areas and high-candlepower lamps in large high studded areas where shadows can be avoided or are not objectionable. A selection of sizes to meet the conditions results in economy and many engineers are proceeding to make a choice of lamps on the above basis, guided of course by the essentials of good engineering, reliability, simplicity, stability and economy.

Reliability.—Nearly all of the lamps under discussion have been tried out in service and their mechanical fitness is a matter of common knowledge.

Simplicity.—While a choice of a

range of sizes is suggested, this is not inconsistent with the ultimate simplicity of the lighting system. A choice of several sizes of tungsten lamps and a high-candlepower high-efficiency arc lamp creates the necessity of stocking that number of spare lamps but this is offset by the inherent simplicity of the incandescent lamp and the general advantages to be gained. An early standardization of sizes insures subsequent reduplication of the sizes chosen and, as obsolete lamps are slowly weeded out the ultimate simplicity of the lighting system of the works is automatically brought about.

It may be of interest to say in this connection that the Carnegie Steel Company has standardized the 40, 100, 250 and 500-watt Mazda lamps and in addition different plants are using one or two of the new arc lamps.

Candlepower Stability.—The question of candlepower depreciation has been touched on before when it was pointed out that allowances should be made when laying out the installation for the dropping off in candlepower which was bound to take place through life under ideal conditions (inherent depreciation) and that which would take place because of the conditions of service (acquired depreciation). Uniformity of performance is a very desirable quality in an illuminant. The inherent depreciation can be obtained by laboratory tests. The acquired depreciation can only be determined under service conditions and may vary for each installation.

The tungsten lamp has an approximate average inherent depreciation of 5.4 per cent for 1,000 hours of service on high operating efficiency while the luminous arc has an average depreciation of 6.6 per cent for 125 hours of service. In neither case would this depreciation be serious, in fact these lamps show very good characteristics in this respect

Little data exists on the acquired depreciation of lamps although it is hoped to secure such data by tests in the near future. The acquired depreciation depends on the cleanliness of the shop in which the lamps are used, the frequency with which lamps are cleaned and the construction of the lamps. The acquired depreciation will under the best conditions vary between zero and a maximum during a period representing the time between lamp cleanings. Experience shows that it is desirable to care for all types of lamps frequently.

Radiations in Incandescent-Lamp Bulbs.

In a communication recently presented to the Paris Academy of Sciences, L. Houllevigue describes some peculiar light effects observed in glow lamps with carbon filaments which do not appear to have been studied before. When a glow lamp is joined to a circuit of excessive potential, a bluish glow fills the bulb for a little while after the current is switched on. The phenomenon is only visible or distinct for a short time—rarely more than a minute—though the lamp will continue to burn. The greater the excess potential, the more rapid will be the extinction. The spectroscopic examination shows that mercury vapor is present. When a magnet is brought near the bulb, the glow becomes concentrated in the tube of force which passes through the filament. The suggested explanation does not explain the action of the magnet. Electrons emanating from the filament in all directions are supposed to ionize the residual mercury vapor, which would then produce a spectrum; the magnetic field should cause the electrons to gather in a helix; but the special experiments made by Houllevigue do not conform to this view. He fitted a bulb with a lateral tubular projection, facing the loop of the carbon filament, and connected the bulb to a Gaede pump, by means of which he maintained the air pressure at less than 0.001 millimeter of mercury for hours; at the entrance to the side tube he placed a diaphragm 6 millimeters in diameter. The filament was for a 50-volt circuit. When the voltage was gradually raised to 80 volts the glow was seen to fill the bulb. Suddenly it would traverse the diaphragm and enter into the tube, in which it would attain a length of seven centimeters. The length of the luminous column would increase with a rise of temperature and with an improvement in the vacuum; when a little air was admitted, the column would shorten temporarily, but would become longer again, probably because the air was being absorbed by the carbon. When the magnetic field was applied to this bulb, it was found that the magnet always shortened the length of the column; the direction of the field had no influence. Experiments with tungsten filaments did not show the phenomenon.

The Radiating Properties of Incandescent Lamps.

A recent article by Johannes Russner, in the *Elektrotechnische Zeitschrift*, describes some experiments intended to measure the percentage of the total radiation of incandescent lamps which is visible to the eye. The method consisted in surrounding the lamp with a thirty-per-cent solution of ferro-ammonium sulphate, thirty millimeters in thickness. This solution has the property of almost completely absorbing the invisible radiation, while permitting the passage of all visible rays. The absorption of radiation by the solution raises its temperature, which was measured by a delicate thermometer. The second experiment consisted in surrounding the lamp with tin foil coated with lampblack and immersing it in the same solution. After another equal interval the rise in temperature of the solution was again measured, this being due to the total energy of radiation. In the second case the rise in temperature is slightly greater than in the first.

The experiments were made with both carbon and metal lamps at different voltages, the results being shown in the accompanying table. From this it appears that the percentage of visible energy of the metal lamp at normal voltage is about 4.4, while with the carbon lamp it is only 1.6. In the table, lamp No. 1 has a carbon filament and lamps Nos. 2 and 3 have metal filaments, presumably of tungsten.

No.	Volts.	Watts.	Percentage of Visible Radiation.	Watts of Visible Radiation.	Horizontal Intensity in Hefners.	Watts per Hefner.	Watts per Candle.
1	115	57.5	1.56	0.9	18	3.28	3.65
	125	70.0	2.2	1.54	32	2.19	2.43
	135	83.7	3.1	2.59	51	1.59	1.77
2	60	40.2	4.3	1.73	42	0.95	1.05
	70	51.8	5.3	2.75	70	0.74	0.82
	80	64.0	6.0	3.84	111	0.58	0.64
3	115	35.7	4.5	1.6	29	1.23	1.37
	125	40.0	5.2	2.1	45	0.89	0.99
	135	45.9	6.0	2.8	54	0.85	0.94

Platinum Production Small in the Year 1910.

The entire production of crude platinum from placer mines in the United States for last year, as well as for 1909, came from the States of California and Oregon. This production in 1910, according to Waldemar Lindgren, of the United States Geological Survey, was 390 troy ounces, valued at $9,507, a decrease of 282 ounces and $3,296 compared with the figures for 1909.

Industrial Power

PUMPING WATER FOR CITY SUPPLY.[1]

BY E. MACDONALD.

The man who undertakes to pump water for a city's needs, must meet and overcome many of the same problems which are encountered in the central station such as friction load, the percentage of efficiency of various makes and sizes of working units, the transmission loss, and, above all the peak load. Not only are the problems similar but many of them may be solved in the same manner. A small friction load and high efficiency may be obtained in either case by careful selection of working units and their auxiliaries.

Transmission loss may be overcome in pipes or wires by increasing the size of feeders, or by raising the initial pressure; and the peak load may be provided for by installing one or more extra units, to be used during the time of peak-load demand; but while the peak load of a central station is encountered, in a greater or less degree, every day during the early evening hours, the peak load of a pumping station may occur but once a year, perhaps never, yet it should just as certainly be provided for as is the peak load of the central station. In fact it is more important, for it may come at any hour of the day or night, it will come unannounced and must be taken care of almost instantly, otherwise the pumping station will prove itself a dismal failure.

The peak load of a pumping station occurs when a great conflagration threatens to destroy the city, and enormous quantities of water, many times more than is ordinarily required and furnished at much greater pressure, must be pumped into the mains and delivered to the fire fighters. And any one pumping station cannot be compared exactly with any other pumping station, for conditions are widely different in different cities.

[1] Paper read before convention of Illinois State Electric Association at Rockford, Ill., October 25, 1911.

For purposes of comparison, let us assume a city of 6,000 inhabitants situated on the prairies of Illinois, with a dozen small industries and one or two large ones. The average daily consumption of water is 800,000 gallons. The minimum daily demand is 420,000 gallons. The maximum daily demand is 2,000,000 gallons, while the maximum rate of demand is 3,000,000 gallons or more; the latter occurring only when a big fire is in progress. In such a city it is found that two steam pumping units have been installed, each of 1,500,000-gallons capacity. A stand pipe or water tank is so arranged that it will fill gradually with excess water being pumped, and when pumping ceases, the tank will supply the city for several hours, especially in the night, and the tower inlet pipe is so arranged that it may be closed quickly in case of fire, so that direct pressure can be delivered to the fire hydrants.

Theoretically, in such a pumping station the cost of fuel per million gallons of water pumped is about $4.00, coal being delivered in the bins at $1.50 per ton, and the station labor cost per million gallons pumped is $3.50, but the theoretical condition is seldom if ever maintained in a pumping station, operated by city employees, for any great length of time after the pump manufacturers have finished their official tests. The pumps become worn, the boilers encrusted with scale, and all the minor appliances more or less defective, and it is not at all unusual to find such a pumping station using three or four times as much coal as the above theoretical amount. Data which have been compiled from reports received from a large number of cities in Illinois, ranging in population from 3,000 to 15,000 where the city is doing the pumping with steam pumps, show that the average cost for fuel per million gallons pumped, is $20.66, and the average cost for station labor is $16.98, making a total average cost for fuel and labor of $37.64. One city shows a fuel cost of $78.80 and is anxious to know how it can better its condition. One remarkable fact shown is that where the labor cost is high, the fuel cost is low and vice versa. The station labor is included because it is one large item of cost which can be eliminated if the pumping is done by electricity delivered from the central station. There are some small items of cost such as oil, waste, etc., not taken into account in this article, which can be saved, and there are large items of cost such as interest, depreciation, etc., which must continue, unless the central station shall install extra pumping units to take care of the peak load. If this is done and the steam pumps are abandoned, then the central station becomes liable to a double peak load, for the peak of the pumping may occur at the same time as the lighting peak, and to properly take care of such a contingency would involve a large investment by the central station which would probably seem unwarranted. Therefore the most simple plan whereby this pumping could be done by electricity, delivered by the central station, would be to install one motor-driven pump of sufficient capacity to take care of all ordinary demands, pumping the water during the hours when the central station load is light, and when the peak lighting load is on, the motor pump can be stopped, and the tank supply can be used, the steam pumps being held in reserve for fire purposes. Under such conditions, if the central-station manager can sell current for power during his off-peak load at five cents per kilowatt-hour and make a profit, he can pump the water with a motor-driven pump for about $22.20 per million gallons and realize the same profit. Similarly at four cents, the price per million gallons would be $17.76, at three cents, $13.32, and at two cents, it would be $8.88.

So it appears that he can prove a large saving to the average city at a price of five cents or less per kilowatt-hour. One central station in Illinois is now pumping the city supply for six and one-half cents per thousand gallons. That is a good price, provid-

ed the amount is accurately measured, and not wrongfully assumed. Another central station is pumping for five cents per kilowatt-hour, and the city reports that it is a great deal cheaper than the old method of pumping by steam. Another city is just getting ready to have its pumping done at two cents per kilowatt-hour.

With the plan mentioned above, the central station cannot save to the city its entire station-labor cost, for a man must be kept in readiness to operate the reserve steam pumps in case of fire or electrical breakdown, and the boiler fires should be kept well banked. For this reason it may be claimed that the most nearly ideal pumping station, one wherein the greatest number of safeguards against a possible failure to deliver service when demanded can be maintained, and at the same time where the highest standard of efficiency in pumping may be secured at the smallest cost, would be one having the steam pumps, held in reserve for fire or other emergency, a motor-driven pump just large enough to take care of ordinary domestic service, and the electric generators, all contained in one building, and so arranged that one force of employees can operate them at any time as may be required. Such a station is in Lincoln, Ill. The equipment consists of two generators, each belted to its corresponding engine, a gearless, upright, duplex, plunger pump having a capacity of 1,250,000 gallons per twenty-four hours, which is belted to a seventy-five-horsepower, sixty-cycle, three-phase, 2,300-volt induction motor. There are two compound double-acting steam pumps, each of 1,250,000 gallons capacity. A battery of four boilers is provided, the boiler nearest the steam pumps being so arranged that it can be disconnected from the other boilers and steam header pipe, and used to operate the steam pumps entirely independent of the electric portion of the station. It is doubtful if any situation might arise which would prevent the pumping of water, excepting a boiler explosion, wrecking the entire station.

A stand pipe is used which is equipped with a check valve opening outward. Around this check a by-pass is constructed, the opening of which may be regulated by moving a lever. Ordinarily the by-pass opening is equal to one 2.5-inch fire-hydrant nozzle.

The motor-driven pump being constant speed, it is arranged to pump the average daily consumption of water in thirteen hours, the excess water being forced into the stand pipe (which has a capacity of 150,000 gallons) and is stored for use when the pump is idle. The pump is usually operated between the hours of 1 to 4 and 6 to 9 a. m., and 1 to 6 and 9 to 11 p. m.

When a fire occurs this pump is started, if at the time it is idle, or simply allowed to run at its constant speed if it happens to be in use. One of the reserve steam pumps is started or both if needed, and the pressure is regulated at about 110 pounds for fire, the pressure carried for domestic use being 60 pounds. With this arrangement a fire pressure can be raised within two minutes' time.

It has been found by tests that this motor-driven pump will operate with 6,374 pounds less coal per 1,000,000 gallons pumped than will either of the steam pumps. The coal used is a very dirty grade of slack and it requires an average of 444 kilowatt-hours per 1,000,000 gallons of water pumped. No extra labor is needed.

Resistance and Arc Smelting Furnaces.

Last year W. Conrad, of Vienna, made an attack on resistance furnaces with special regard to the smelting and melting of iron and steel. He described in *Stahl und Eisen*, some experiments conducted at the steel works of R. Lindenberg, of Remscheid. The experiments may not be conclusive, but they have scarcely received due attention. Conrad's argument is that, with the practically feasible current intensities, it is out of question to heat a liquid conductor like iron by using it as a resistance. The ordinary laboratory experiments are made in resistance furnaces rather than in arc furnaces, because the former are more convenient. Laboratory furnaces can be cooled, moreover, when the high temperatures make the walls conductive, but that is hardly possible in practice; hence carborundum furnaces are worked for a time and then dismantled. When the liquid resistance conducts much better than the furnace material, the objection that the walls also conduct would not be fatal. But when that is so, the liquid conductor does not absorb the current energy to a profitable degree. Potential measurements which Conrad made in calcium-carbide furnaces, in which arc and resistance heating are combined, convinced him that only one per cent of the heat energy consumed was due to the conduction of the current through the mixture, while the arc supplied ninety-nine per cent, and it could be seen that the carbide formation was taking place chiefly where the arc had been playing. In his experiments on iron he filled a furnace with 1,300 kilograms of steel (one per cent of carbon) after raising the two suspended electrodes. He inserted into the bath two oblique steel rods, 3 meters in length, 36 milimeters in diameter, as test electrodes for the resistance determinations with direct currents. These determinations were made 28 and 53 hours after filling the furnace; the gradual heating of the furnace by the fluid metal, it was found, made very little difference in the resistance values. The cold electrodes had a resistance of 0.000117 ohm per meter; the total resistance of the bath was 0.00085 and 0.00080 ohm (first and second measurements), and the resistance of the bath alone 0.00027 and 0.00026 ohm. That would yield a specific iron resistance of 22 ohms per meter length and square millimeter section; and the liquid iron would therefore conduct only one-twenty-second as well as mercury, and one-two-hundredth as well as cold iron. This conductivity of the iron was really lower than one should expect, supposing the resistance of iron with rising temperature to increase at the rate shown by ordinary experiments. But in any case the resistance would be far too small for efficient resistance heating. Since the liquid iron is no longer magnetic, it is the I^2R heat, which is of moment, and for this particular arc furnace, which is fed by two arcs in series at 3,000 amperes and 110 volts, the 0.00027-ohm resistance would only absorb 2.4 kilowatts, which means 0.73 per cent of the energy which the two arcs could supply. The heat generated in this way would be about that of a small iron stove, and could easily be balanced by cooling. A resistance furnace with cooled electrodes would therefore be apt to lose more heat through the electrodes than they could introduce, and to secure efficient heating, currents of enormous intensity would be required. These considerations would affect direct-resistance steel furnaces of the Gin and also of the Girod types.—*Engineering.*

Questions and Answers

All readers of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN are invited to submit questions and answers to this department. Correspondents are requested to send full name and address. This, however, will not be printed except where the writer indicates his willingness therefor. Anonymous communications will not be considered.

Questions relating to electrical matters of any kind will be inserted. Answers from our readers should be received in this office preferably within ten days of the date of publication of the question. Answers will be published in a subsequent issue.

QUESTIONS.

No. 26.—ELECTROLYTIC RECTIFIER.—Please describe and give sizes of the simplest form of electrolytic rectifier consisting of aluminum and lead plates in ammonium phosphate solution, to be used for charging (at least two at a time) automobile ignition batteries on 110-volt alternating-current circuit.—J. S., Alameda, Cal.

No. 27.—HEATING A NEEDLE ELECTRICALLY.—I would like to know how to heat by electricity, from one end only, a needle of the size of a darning needle, which must have its other end entirely free from any kind of an object.—N. D. R., Kokomo, Ind.

No. 28.—INDICATIONS OF FULL CHARGE IN A STORAGE BATTERY.—Are there any simple but reliable signs which indicate when a common storage battery has a full charge?—P. E., Dixon, Ill.

No. 29.—MULTIPLE-UNIT SYSTEM FOR ALTERNATING-CURRENT RAILWAYS.—Is it possible to operate a number of cars in a train on the multiple-unit system when alternating current is used on the trolley?—J. Q. R., Evansville, Ind.

No. 30.—DANGER FROM X-RAYS.—I have heard of serious burns resulting from frequent exposure to X-rays. Is there not danger, therefore, when it is proposed to use X-rays in a series of treatments for a malignant skin disease?—W. N., Topeka, Kans.

ANSWERS.

No. 21.—EFFECT OF FLASHING ON LIFE OF TUNGSTEN SIGN LAMPS.—Is the life of tungsten sign lamps shortened when they are used in connection with a high-speed flasher? Is such a flasher adapted for carbon-filament lamps only?—S. M., Peoria, Ill.

The actual burning life of tungsten sign lamps is not appreciably affected by using them in connection with a flasher. The cold resistance of a tungsten lamp is lower than its hot resistance; therefore, each time it is switched on it receives a slightly heavier starting current than the normal steady current and this results in a momentary initial flash. On the other hand, a lamp that is used in a flashed sign has a lower average temperature than one in a steadily burning sign. These two effects probably neutralize each other so that the net effect on the life of a flashed tungsten lamp seems to be nil. Flashers, whether of low or high speed, are equally serviceable for all kinds of incandescent lamps.—M. D. S., Chicago.

No. 23.—TROUBLE IN WIRELESS SENDING.—I have just started some work in wireless telegraphy and am having fine results in receiving, but a great deal of trouble in sending. I have a seventy-foot, three-wire aerial. When I connected the coils to the 110-volt lighting circuit in the house, I got a good spark across the spark gap, but as soon as I threw in my aerial and ground it burned up the wire in the electric light fixtures all over the house and a few minutes later blew all the fuses except the ones on the wireless circuit. When this happened I was using a gas-pipe ground. Later I tried a water-pipe ground and then it would not blow the fuses but sparks would jump from the fixture stems and from the broken wires; our fixtures all have insulating joints and are not grounded. I do not understand why I had so much trouble after the aerial and ground were connected and yet got a good spark before. My sending set consists of two Dow spark coils connected in series, sulphuric-acid interrupter, spark gap, condenser and key. Other amateurs in this city are using 110 volts and gas-pipe grounds with fine results, while I have tried various grounds and cannot send out.—J. C. S., Cleveland, Ohio.

Although all the particulars are not made clear in the question, the trouble is probably caused by the high-tension current in the secondary circuit reacting on the primary and thus setting up in its circuit a momentary high-tension charge or surge which breaks down the insulation between the 110-volt circuit and ground. I have had some trouble of this nature but not more serious than blowing the nearest fuses of the lighting circuit and burning out the insulation of the wires used to connect to the primary. I overcame it by putting a pair of condensers across the primary circuit between the coil and the lighting circuit and connecting the point between them to ground. This formed a discharge path for the inductive surges set up in the primary, so that they did not back up into the lighting circuit. I always use a water-pipe ground.—H. B. R., Milwaukee, Wis.

No. 24.—SIZE OF HEATING APPLIANCES THAT MAY BE CONNECTED TO LIGHTING CIRCUITS.—What is the largest size or rating in watts of electric heating appliances that may be connected to an ordinary house lighting circuit carrying 110 volts alternating current? Is it necessary to provide an extra circuit for an electric range?—H. F., Des Plaines, Ill.

The ordinary house lighting circuit, whether direct current or alternating current, is limited by the National Electrical Code to a load of 660 watts. If it is a 110-volt circuit, it must be provided with a six-ampere fuse. Now, if the lamps on the circuit consume but 110 watts, then there may be added 550 watts in heating appliances; in other words, the sum of the heating and lighting loads must not exceed 660 watts in order to receive the approval of an electrical inspector. It is true that on lighting circuits already well loaded with lamps, one of these is sometimes removed and an appliance, such as a flat-iron taking 450 watts, is plugged in, making the total load greatly exceed 660 watts if the lamps were turned on at the same time; the latter is seldom the case, however, for if it were there would be more frequent blowing of fuses. Should an electric range require 660 watts, no lamps would be permitted on its circuit; should it require more than 660 watts, a special circuit of sufficient carrying capacity must be provided for it.—E. I., Chicago.

BOOK REVIEWS.

"Copper Handbook." By Horace J. Stevens. Tenth edition. Houghton, Mich.: Horace J. Stevens. Cloth, 1,902 pages (5½ x8½ inches). Supplied by the Electrical Review Publishing Company for $5.00.

The tenth annual edition of the Copper Handbook, which is considered a standard authority on the subject of copper and copper mines for the entire globe, has 1,902 octavo pages, containing nearly 1,500,000 words, and, in addition to the miscellaneous chapters, lists and describes 8,130 copper mines and copper mining companies, in all parts of the world, this being the largest number of titles ever listed by any work on mining. The descriptions range from two or three lines, in the case of dead companies, wherein reference is made to detailed descriptions in past volumes at the period of their activity, up to twenty-one pages in the case of the Anaconda Mine. The miscellaneous chapters of the book, twenty-four in number, treat the subject of copper from all possible viewpoints, there being chapters on the history, chemistry, mineralogy, metallurgy, brands and grades, alloys and substitutes for copper, with a copious glossary, and a chapter of statistics ending the book that contains 40-odd tables, thoroughly covering copper production, consumption, movements, prices, dividends, etc.

"Electric Traction and Transmission Engineering." By Samuel Sheldon and Erich Hausmann. New York: D. Van Nostrand Company. Cloth, 307 pages (5x8 inches), illustrated. Supplied by the Electrical Review Publishing Company for $2.50.

This book treats of the facts that are to be considered in determining the final elements of a complete electric traction system. It presents a perspective view of the design of a complete railway installation from the cars to the power station and indicates the nature and sequence of the various entailed problems, suggesting and illustrating methods for their solution. A descriptive treatment of specific forms of structure has been avoided. On the other hand, a number of numerical illustrations of the calculations of economic magnitudes has been given, which adds considerably to the value of the book. The early chapters of the book deal with the determination of the number and size of cars for an urban road; the tractive effort required; type of motor required; control; distributing system. The concluding chapters deal with the types of substations needed under various conditions, selection of the proper method of transmission and power stations.

"Electric Central Station Distribution Systems." By H. B. Gear and P. F. Williams. New York: D. Van Nostrand Company. Cloth, 347 pages (5x8 inches), illustrated. Supplied by the Electrical Review Publishing Company for $3.00.

This book is a thoroughly practical work treating of the most recent practice in distribution and transmission of electrical energy. The subject matter has been treated entirely from an American point of view, the distribution methods of several of the larger central-station companies in this country forming a considerable portion of the text. Some of the subjects discussed in the various chapters are: systems of distribution; transmission and conversion; voltage regulation; line transformers; secondary distribution; protective apparatus; overhead construction, underground construction and cable work. Of particular importance are the two concluding chapters in which are compiled such tables as are likely to be needed by the distribution engineer, together with a brief outline of the laws of electric circuits.

"The Principles of Electrical Engineering." By Harold Pender. New York: McGraw-Hill Book Company. Cloth, 438 pages (6x9 inches), illustrated. Supplied by the Electrical Review Publishing Company for $4.00.

This book is an exposition of the physical principles upon which the art of electrical engineering is based, together with a discussion of the application of these principles in some of the simplier forms of apparatus and machinery. The first four chapters of the book are an introduction to the study of direct-current machinery, the last five of the detailed study of alternating-current machinery and the transmission and distribution of energy by alternating currents. The method of treatment adopted throughout is to describe first certain simple and typical experiments which illustrate a given principle, second, to state the principle in an exact manner in its general form, and then explain the application of the principle in one or more general cases. Problems are given at the end of each chapter.

"The Telegraphic Transmission of Photographs." By T. Thorne Baker. New York: D. Van Nostrand Company. Cloth, 146+xi pages (5 x 7¼ inches) with 66 illustrations. Supplied by the Electrical Review Publishing Company for $1.25.

This is a non-technical description of several of the processes used in phototelegraphy. The book opens with a brief history of former attempts at the solution of the problem. The experiments of Professor Korn are described at some length, both as to the selenium-cell method and the later telautographic method. The author's own telectrograph system is then explained. The effects of leakage, resistance, inductance and capacity of telephone and telegraph lines are pointed out. Belin's telestereograph is described and the final chapter is devoted to experiments aiming to transmit pictures and photographs by wireless telegraphy. Throughout the book are given numerous diagrams of the various apparatus used and reproductions of pictures actually transmitted. Most of the work undertaken in this line has been on behalf of enterprising newspapers in England and on the Continent. The book is a good review of this highly interesting development.

"A Handbook of Wireless Telegraphy." By James Erskine-Murray. New York: D. Van Nostrand Company. Third edition, cloth, 386 pages (5½ x 8½ inches), with 195 illustrations. Supplied by the Electrical Review Publishing Company for $3.50.

A technical book that reaches its third edition within four years must either treat of a topic receiving much attention or treat its subject matter in such a clear and thorough manner that it comes to be regarded as an authority. Both these causes account for the book in hand. It deals with a subject of general interest, it is well written and is thoroughly up to date. It has been revised throughout and much new material added; some portions that have become obsolete have been left out. Like the previous editions, the present work is not intended for beginners, but rather for those who have an acquaintance with at least the most important fundamental principles of wireless telegraphy. The book may be divided into three main parts, the first dealing with the general details of various sending and receiving apparatus, the second describing the most common wireless systems in use, and the third reviewing the modern theories, methods of adjusting, testing and calculation.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

UNITED TRACTION COMPANY (ALBANY.)

The report of the United Traction Company to the New York Public Service Commission, for the quarter ended June 30, 1911, compares as follows:

	1911.	1910.
Total operating revenue	$583,971	$537,561
Total operating expenses	332,433	314,286
Net operating revenue	251,538	223,274
Taxes accrued	36,000	33,000
Operating income	215,538	190,274
Other income	50,721	51,455
Total income	266,259	241,730
Charges	102,470	96,625
Surplus	163,788	145,104

AURORA, ELGIN & CHICAGO.

The report of the Aurora, Elgin & Chicago Railroad Company for the month of September and three months ended September 30, 1911, compares as follows:

	1911.	1910.
September gross	$167,422	$161,598
Expenses	84,406	83,177
September net	83,016	78,421
Charges and taxes	36,371	33,054
September surplus	46,645	45,368
Three months gross	542,975	522,715
Expenses	268,693	258,266
Three months net	274,282	264,449
Charges and taxes	109,289	98,661
Three months surplus	164,993	165,788

AMERICAN LIGHT & TRACTION RAILROAD.

The report of the American Light & Traction Railroad Company for the month of September and nine months ended September 30, compares as follows:

	1911.	1910.
September gross	$ 346,372	$ 335,100
Expenses	9,092	9,562
September net	337,280	325,538
Nine months gross	2,925,703	2,653,157
Expenses	83,869	89,424
Nine months net	2,841,834	2,563,733

CONEY ISLAND & BROOKLYN.

The Coney Island & Brooklyn Railroad Company has issued its report for the year ended June 30, 1911. The income account compares as follows:

	1911.	1910.
Operating revenue	$1,538,003	$1,470,672
Operating expenses	982,007	1,011,831
Net operating revenue	555,995	458,841
Taxes	92,572	80,519
Operating income	463,423	378,322
Other income	25,954	2,026
Total income	489,377	380,348
Interest and rent	308,242	288,571
Net corporate income	*181,135	91,777

*Equal to 6.07 per cent on $2,983,900 capital stock, as compared with 3.76 per cent earned on same stock last year.

KINGS COUNTY ELECTRIC LIGHT & POWER.

The report of the Kings County Electric Light & Power Company for the month of September and nine months ended September 30, 1911, compares as follows:

	1911.	1910.
September gross	$ 377,816	$ 352,889
Expenses	195,735	181,942
September net	182,080	170,947
Charges, depreciation, etc.	118,856	109,015
September surplus	63,224	61,932
Nine months gross	3,443,533	3,146,503
Expenses	1,733,328	1,519,816
Nine months net	1,710,205	1,626,687
Charges, depreciation, etc.	1,026,280	933,514
Nine months surplus	683,925	693,173

AMERICAN CITIES COMPANY.

The combined earnings of the constituent properties of the American Cities Company for the month of September and twelve months ended September 30, 1911, compare as follows:

	1911	1910
*September gross	$1,125,412	$1,062,989
Expenses and taxes	679,955	642,802
September net	445,457	420,187
Interest, sinking funds, etc.	255,120	241,594
September surplus	190,337	178,593
*Twelve months gross	13,146,319	12,437,190
Expenses and taxes	7,886,519	7,513,023
Twelve months net	5,259,800	4,924,167
Interest, sinking funds, etc.	3,008,862	2,916,031
Twelve months surplus	2,250,928	2,008,136

*All sources.

PUBLIC SERVICE CORPORATION.

The Public Service Corporation of New Jersey and subsidiary companies reports to the New York Stock Exchange for the nine months ending September 30, 1911, as follows:

Gross earnings of operating companies	$21,975,080
Income from sec. pledges and miscel. sources	1,391,455
Total earnings	23,366,536
Oper. expenses and taxes	12,111,211
Net earnings	11,255,324
Fixed charges of operating companies	8,269,553
Balance	2,985,770
Fixed charges of P. S. C. of N. J.	1,870,098
Combined surplus of P S. C. of N. J. & sub. cos.	1,115,672
Previous surplus (plus adjustment)	1,707,698
Total surplus	2,323,370
Dividends paid to Sept. 30, 1911	1,125,000
Surplus	1,698,370
Profit and loss of sub. cos. not taken upon books of P. S. C. of New Jersey	718,020
Bal. to credit of profit and loss Sept. 30, 1911	980,350

LAKE SHORE ELECTRIC.

The report of the Lake Shore Electric Railway Company for the month of August and eight months ended August 31, 1911, compares as follows:

	1911	1910
August gross	$143,584	$139,896
Expenses and taxes	68,507	59,962
August net	75,077	79,934
Charges	34,913	34,719
August surplus	40,164	45,215
Eight months gross	837,469	798,655
Expenses and taxes	443,620	418,744
Eight months net	393,849	379,911
Charges	277,687	278,080
Eight months surplus	116,162	101,831

PHILADELPHIA ELECTRIC.

The report of the Philadelphia Company for the month of September and six months ended September 30, compares as follows:

	1911	1910
September gross	$1,554,759	$1,538,370
Expenses	1,053,348	938,320
September net	501,411	600,050
Six months gross	9,673,247	9,838,149
Expenses	6,116,839	5,618,329
Six months net	3,556,408	4,219,820

NASHVILLE RAILWAY & LIGHT.

The report of the Nashville Railway & Light Company for the month of September and twelve months ended September 30, 1911, compares as follows:

	1911	1910
September gross	$179,132	$163,307
Expenses and taxes	98,312	89,522
September net	80,819	73,785
Charges	39,294	38,288
September surplus	41,525	35,497
Nine months gross	1,440,175	1,341,847
Expenses and taxes	849,789	777,993
Nine months net	590,386	563,854
Charges	346,058	342,448
Nine months surplus	244,328	221,405

AMONG THE CONTRACTORS AND SUPPLY MEN

HANN & PUGH, Birmingham, Ala., recently installed electric lights in the Post Office at Birmingham.

JOHN HUGHES, of Champaign, Ill., has purchased the electrical contracting business formerly conducted by A. E. Price of that city.

THE LENNAN ELECTRIC COMPANY, Des Moines, Iowa, was awarded the contract for wiring the reconstructed cavalry stables at Fort Des Moines.

THE McFELL ELECTRIC COMPANY, San Francisco, Cal., is installing the electric lighting system at Fort Miley, Cal. The amount of the company's bid was $17,200.

M. M. STAUM of Pasco, Wash., has purchased the business of E. Fluke and will continue to run his electrical supply house. Mr. Staum has for several years been identified in local business affairs.

THE ROSENBERRY - HENRY ELECTRIC COMPANY, Grand Rapids, Mich., has been awarded the contract for installing a conduit and wiring system in the United States Post Office at Grand Rapids at $730.

F. E. NEWBERY ELECTRIC COMPANY, Chicago, Ill., has incorporated with a capital of $25,000 to do a general business as well as engineering, contracting, etc. The incorporators are F. E. Newbery, B. H. Bendheim and Francis Adams.

ERVIN KEELER, electrical contractor of Amsterdam, N. Y., reports activity in electrical lines in that town. This is accounted for largely by both prosperous conditions in Amsterdam and the cheap rate on electric current furnished by the power company there.

EDWARD JUMONVILLE, secretary-treasurer of the Interstate Electric Company, Ltd., of New Orleans, La., since its organization in 1903, and Reynolds Yundt of the same organization, are making arrangements to go into the electrical-supply business in New Orleans.

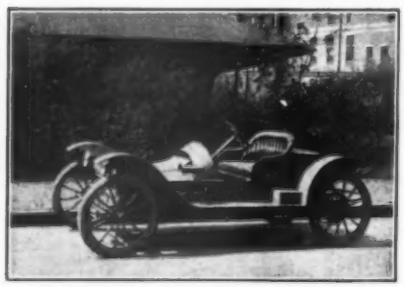
Exports of Copper.

Exports of copper for the week ended October 26, were 7,151 tons. Since October 1 the figure given is 18,814 tons, as compared with 22,246 tons for the same period last year.

New Electrical and Mechanical Apparatus and Appliances

New High-Speed Electric Roadster.

S. R. Bailey & Company, Amesbury, Mass., manufacturers of electric vehicles for five years past and of carriages for some sixty years, has brought out after two years of experimenting, a roadster capable of performance that is said to be heretofore unknown in the electric field. The Bailey concern was first prompted to manufacture this car through the statement of the Edison Electric Illuminating Company of Boston that it would replace with electric vehicles all gasoline passenger cars used by heads of departments, etc., as soon as electric vehicles were manufactured which could do the work as the gas cars do it. The requirements in one class of work were that a car should cover in



BAILEY ELECTRIC ROADSTER.

a day eighty miles in four hours running time under all ordinary conditions.

In the Bailey roadster, a car has been brought out which is said to be fully capable of this work, as has been fully demonstrated during the last three months of road tests. All records for electric cars were broken by the Boston-New York run made by this car—244 miles in 12 hours and 12 minutes running time, or at an average speed of twenty miles per hour—and the Edison Company's observer having reported the results of this record-breaking trip to his Company, an order has been received for six duplicates of the Bailey roadster for immediate delivery to replace gas cars now in use.

The car is entirely distinct in design from any gas car or electric. Every effort has been made to make the car the lightest running one possible and in this regard wind resistance has been reduced to a minimum.

The car is set very low to the ground, the weight being carried extremely low but at the same time being suspended from the upper side of the springs. The frame is of novel wood construction, strongly braced with steel and capable of withstanding every strain.

The chassis is on a three-point suspension. There are the conventional full elliptical springs in the rear, and in front is a cross spring from which the upper part of the body is suspended. The action of the front spring and axle produced by this arrangement results in the car's being capable of traveling over the worst of roads at high speed, with no discomfort to passengers.

The standard battery equipment of this car is sixty cells of the A-4 Edison type, giving a mileage of between 80 and 100 at twenty miles per hour. At a somewhat lower speed this mileage can be increased to well over 200 miles. With special motor equipment the car can attain a speed of forty miles per hour where such speed is required. The motor is of General Electric manufacture, rated at 48 volts.

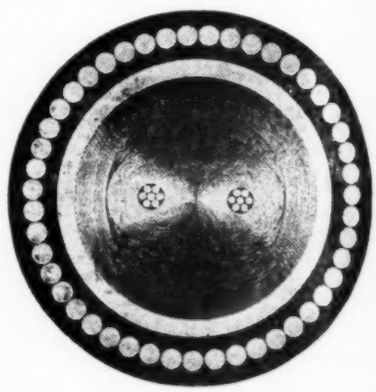
The motor is suspended under the rear hood on a three-point suspension. The drive is by means of silent chain to jack-shaft, power being transmitted from jack-shaft to rear wheels by the conventional and most generally approved double-chain drive. A wheel steer is used, with speed controller mounted on top, similar to the throttle on a gasoline car, giving eight speeds forward and four reverse.

130,000-Volt Cable.

The accompanying illustration shows the construction of an English cable of the Henley design which withstood successfully a pressure of 130,000 volts for ten minutes. This high-tension cable was constructed for use at the Clifton and Glace Bay stations of the Marconi Wireless Telegraph Company, Ltd.

This cable was insulated with impregnated manilla paper, lead-sheathed and wire-armored. It was designed to carry current at 30,000 volts pressure to the transmitting house from the power station, the current being generated by series direct-current dynamos for charging accumulators. This cable was to have been tested with a pressure of 56,000 volts between cores and lead, as well as between core and core, as a large factor of safety was required.

As above mentioned, in actual test the cable successfully withstood a pressure of 130,000 volts for ten minutes,



130,000-VOLT CABLE.

this high pressure being reached by gradual stages, without any interval of rest for recovery between tests. During the test the cable was bent in two places to a radius of seventeen inches. It is maintained that these results constitute a record for high-tension cables, for during the first five minutes a pressure of 75,000 volts was applied, followed by 90,000 volts for a like period of time, when the pressure was increased to 100,000 volts and maintained at that voltage for twenty minutes. Another increase was made to 115,000 volts, the cable being subjected to this pressure for thirty minutes before the final test of 130,000 volts was made. It will thus be seen that the entire length of test was more than an hour with the voltage applied 100,000 volts or higher.

Ornamental Posts.

The Wallace Machine & Foundry Company, Lafayette, Ind., has a foundry which is completely equipped to turn out high-grade ornamental cast-iron posts for street lighting, and its large facilities permit it to handle contracts of any size at very low figures. One of the designs which is being turned out by this company is shown in the accompanying illustration.

Different styles of arms and different arrangements of arms can be furnished to the number of twelve, but the same shaft is used for all. The design of this shaft is very simple and has been much admired. Posts can be furnished for from one to five lights each. This style of post is being largely adopted in Ohio, Indiana, Illinois, Michigan and Iowa.

WALLACE ORNAMENTAL POST.

High-Voltage Type H Transformers.

The high potentials required for the economical transmission of electrical power to great distances make imperative the use of transformers of great electrical and mechanical strength to withstand the heavy disturbances on these long transmission lines and provide the dependable service demanded by the public of today.

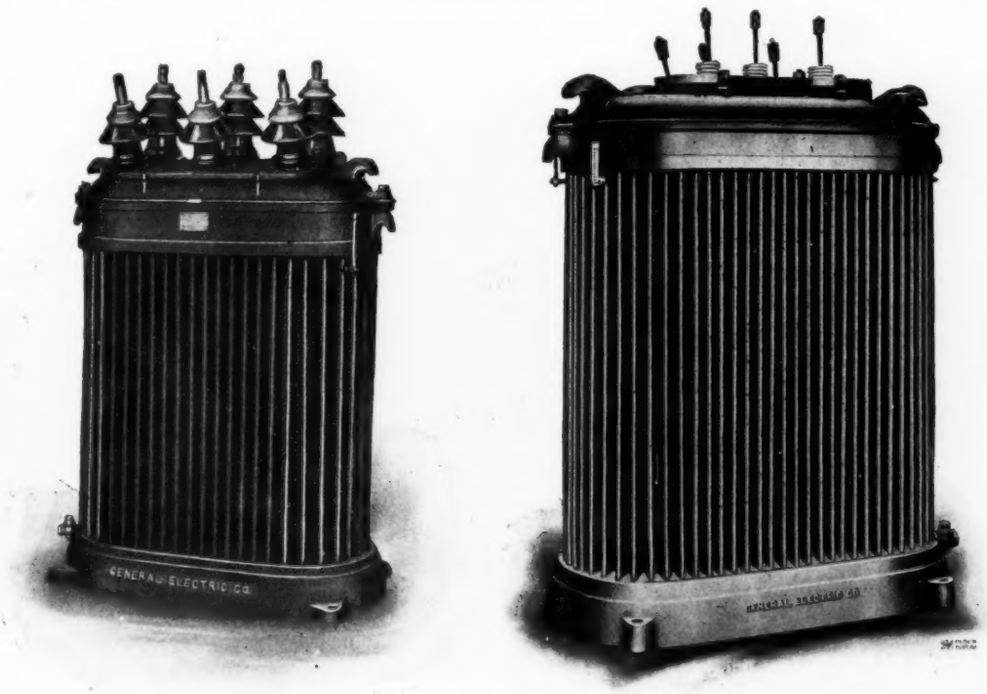
After a close study of the general construction and the details of the design required in transformers for such service, the General Electric Company has decided that its type H (core-type) transformer most fully meets the requirements for high-voltage work on either self-cooled or water-cooled designs, single-phase or three-phase, in capacities up to and including 600 kilowatts for outdoor and indoor service on circuits of any commercial voltage and frequency. Before redesigning this line a study was also made of the insulating materials themselves as well as their distribution throughout the windings to give greatest turn-to-turn and layer-to-layer dielectric strength, and thus insure the greatest possible strength. Striking improvements have been made in the mechanical design to enable the transformers to withstand the strains of long-distance shipment which in many instances are of as great importance as those of operation.

Some of the new features of this line of transformers are as follows: The original method of fastening the laminations together with horn-fiber channels and shellaced wooden dowel pins is superseded by the use of insulated metal rivets. The interleaving of the yoke laminations with the leg laminations is maintained, having proven superior to other forms of joints. A supporting plate furnishes additional mechanical reinforcement to the outside laminations.

The clamps for the yoke laminations consist of steel angle plates. Bolts engaging with these clamps and notches cut in both the yoke and end laminations, contribute to a firm engagement of the clamps and core, giving a rigid mechanical construction.

The coil supports engaging with the steel angle plates consist of treated wooden blocks providing generous bearing surface for the coils. On the higher-voltage designs this wood is supplemented by wet-process porcelain parts, giving greater insulation strength without loss of mechanical strength. These supports are adjustable to correct any tendency for the parts to get out of alinement during transportation and before the transformer is put in service.

The tank for the self-cooled transformer consists of a corrugated-steel



HIGH-VOLTAGE TYPE H TRANSFORMERS.

The World's Largest Locomotive.

In the Topeka shops of the Atchison, Topeka & Santa Fe Railroad Company is being built the largest railway locomotive in the world. It is an articulated compound engine and is for use in hauling freight trains over the Arizona grades. Oil will be used for fuel.

This locomotive is 121 feet long. It will be operated tender foremost, as the great length of the boiler obstructs the view of the engineer.

body amalgamated with a cast-iron base and cast-iron rim. This construction, originally recommended about five years ago, is adhered to, as it gives a thoroughly satisfactory construction, being free from solder or riveted seams which may open up by sudden application of heat externally applied or by sudden sharp mechanical strains.

For the water-cooled transformers the body is of smooth cast iron, which, with the base and rim are made in one piece. The cooling coils for these transformers have both inlet and outlet brought out at the side below the oil level so that no portion of the cooling coil is exposed to the air, effectively preventing any condensation of moisture from the atmosphere and consequent deterioration of the oil. These pipes may be of copper, brass or iron, determined by the purity, etc., of the cooling water. The bases of both self-cooled and water-cooled transformers are provided with lugs to facilitate skidding, and also with smooth bottoms to facilitate handling by rollers, etc., in transportation.

By a proper distribution of the metal and reinforcing by deep ribs such portions of the cover as are subject to strains, a very light construction is made possible. Hooks of unusual strength are provided so that the transformer itself, or complete tank and oil, may safely be raised or lifted by them.

Bushing plates are placed over large openings in the cover and serve as supports for wet-process porcelain bushings through which the leads enter the case. The openings provide access to the interior of the tank for change of connections and facilitate examination without the necessity of removing the transformer itself from the tank.

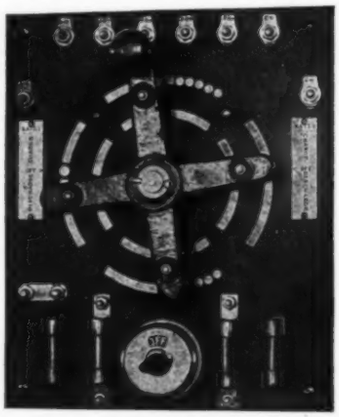
The development, about two years ago, of the outdoor lead and its application to these transformers has made possible a line of outdoor transformers using the same mechanical parts as the indoor type.

The cylindrical windings of core-type transformers are maintained, as this design has proven to be the strongest both electrically and mechanically. These coils, being separately wound and insulated, permit attention to details of insulation not possible where windings are not so manufactured. The use of the vacuum process insures a construction able to withstand the frequent strains and surges, both of normal and high frequency.

Battery-Charging and Transfer-Switch Panel.

Where duplicate sets of batteries are employed it is very desirable and in some cases necessary that a convenient means be provided for transferring batteries on the working line without causing an interruption of even a few seconds. On an electric clock circuit, for instance, if the power were interrupted on the working circuit when the batteries were being transferred by means of an ordinary throw over switch, it might happen that the master clock would make contact for an impulse at just this time. The result would be that the secondary clocks would all be 15 to 20 seconds slow.

The panel illustrated herewith has



BATTERY-CHARGING AND TRANSFER-SWITCH PANEL.

been placed on the market by the Cutler-Hammer Manufacturing Company of Milwaukee. It provides for transferring batteries (such as are used on circuits for electric clocks, railway signals, bells in schools, manufacturing plants, etc.) without interrupting the working circuit, and, also puts one battery on charge while the other is in use.

The four-arm lever shown in the illustration controls both batteries. By moving to the left, battery No. 1 is thrown on the working circuit and battery No. 2 on the charging circuit. Moving the lever in the opposite direction reverses this condition. The charging current can be varied without disturbing the working battery or circuit. Charging line connections can be made direct to any 110-volt direct-current circuit and the voltage of the working circuit can be designed regardless of this.

Provisions can be made for automatically disconnecting either battery when charged and transferring batteries when the working battery reaches a predetermined low voltage.

Lake Shore Adopts Telephone Train Dispatching.

The Lake Shore & Michigan Southern Railway has found the telephone so satisfactory for dispatching trains over its lines that the New York Central recently placed another order with the Western Electric Company for enough of its selectors to equip five new circuits. The Lake Shore & Michigan Southern is already operating about 1,100 miles of circuits by the telephone, and the addition of the five new circuits will bring the total mileage up to about 1,850 miles.

The additional equipment will consist of a train dispatching circuit to run from Hillsdale to Lansing, Mich., with a branch from Homer to Dundee, Mich. The dispatcher for this circuit will be located at Hillsdale, and twenty-six stations will be equipped.

A second train circuit will run from Fort Wayne, Ind., to Jackson, Mich., with a branch off from Bankers to Ypsilanti, Mich. There will be thirty-six stations on this line, and the dispatcher will also be at Hillsdale.

Another train circuit will run from Detroit to Jackson, with a branch off from Monroe, Mich., down to Toledo, Ohio, and another one off from Grosvenor, Mich., to Fayette, Ohio, with a short branch from this line at Lenawee Junction to Adrian, Mich. The dispatcher for this circuit will be located at Detroit, and forty-one stations will be equipped.

In addition, a message circuit will be run from Fort Wayne straight through to Jackson, Mich. On this line twenty-two stations will be equipped. No. 9 copper will be used for all of the above circuits.

Another message circuit will also be run out of Detroit, but there will be no stations on the line between Detroit and Monroe, Mich. From there on, however, to Jackson, with a branch off from Lenawee Junction to Adrian, Mich., and Fayette, Ohio, there will be twenty-two stations equipped.

An interesting feature of this installation is a special switching device which permits the stations between Grosvenor, Mich., and Fayette, Ohio, to be switched over to the train wires when desired. The wire on this circuit will be No. 8 iron and No. 9 copper.

The Printometer.

The printometer is an instrument for use with integrating meters, printing in plain figures on a continuous paper tape the consumption during every interval as registered on the meter with which it is used. It prints the time in a column parallel to that showing the consumption, thus giving also the exact time of day and day of week when the energy was consumed.

The printometer is one of the most useful devices that has ever been developed for a great many varieties of uses connected with the utilization of electrical energy. Through its use the central-station manager can eliminate all possibility of dispute with regard to the customer's use of current, can absolutely prevent mistakes respecting the load-factor of the apparatus connected to the line, and in many other ways secure a perfect and continuous check under every phase of operation. Some of the specific uses to which the printometer may be put are as follows: To obtain the maximum demand and establish equitable rates; to determine the diversity-factor; to determine the load-factor; to regulate the use of off-peak power; to determine the use of breakdown service; to make special tests of power conditions; to make measurements of speed.

The printometer is not an integrating meter, but is an instrument that can be electrically connected to and used with any integrating meter. The register of the meter to which the printometer is to be connected is forwarded to the factory, where a commutator device and binding screws are fitted thereto, after which the register can be put back on the meter by any ordinary meter man. The printometer when properly installed with its contact clock and wired to the binding screws which have been attached to the register of the meter is electrically interlocked with the meter and conforms to its accuracy. The accuracy of the meter, however, is in no wise impaired with its interlocking with the printometer.

PORTABLE PRINTOMETER.

The printometer contains a set of cyclometer type wheels which are electrically interlocked with the register of the meter. They are moved forward with a rate that is exactly equal to the rate of flow of power through the meter and will, therefore, at any instant give an indication which is equivalent to the reading of the dial. Through the agency of a rubber platen and copying ribbon this reading is printed on a paper tape. When this rubber platen is actuated by an electric solenoid whose circuit is closed at regularly recurring intervals by means of a contact-making clock, there is obtained a paper tape which has printed upon it a reading equivalent to the reading of the watt-hour meter at each interval.

The type 3 printometer, an illustration of which is shown herewith, has been developed particularly to meet the special requirements of an instrument for obtaining the maximum demand. This instrument will print upon the paper tape the time of record and the consumption of the watt-hour meter for any desired interval preceding the time of record.

The type S C attachment is a summation or additive reading printometer. The type wheels are always advanced by the cyclometer magnet and are never moved by any other agency. Thus the consumption of any interval is added to that of all preceding intervals and the sum printed opposite the time of record. In order to obtain the consumption for any interval it is necessary to subtract the reading as printed at the beginning and end of that particular interval.

The base of the instrument is circular in form, of cast iron covered with highly polished black lacquer and arranged with holding and terminal studs at the back for mounting and connections. The mechanism is protected by

CONTACT-MAKING CLOCK.

MECHANISM OF PRINTOMETER.

means of a crystal glass cover, which is rendered dust-proof through the agency of a felt ring arranged on the base. The cover is held in position by one stud and thumb nut at its center. The metal parts of the mechanism are plated with a special form of non-tarnishing white nickel. Name plates and coils are finished in dead black.

The contact-making clock is mounted on a base and protected by a glass cover, the base and cover being duplicates of those used with the printometer, making the two instruments exactly alike in outside dimensions and in the location of holding and terminal studs.

The printometer is also made in a portable form, consisting of a carrying case and the printometer and contact clock within. This instrument has been developed to meet the demands

RECORD PRINTED BY PRINTOMETER.

for a self-contained instrument for testing purposes.

This instrument is manufactured by the Chicago Electric Meter Company, and is distributed by the Minerallac Electric Company, 112 West Adams Street, Chicago, Ill. The company has prepared bulletin No. 55, which gives very complete information respecting the electrical and mechanical characteristics of the printometer and explaining in detail its manifold adaptations.

Convenient Means for Determining Flue-Gas Temperatures.

At the basis of all scientific management are quantitative measurements, and one of the most notable developments in modern steam-plant practice is the introduction of all kinds of meters for weighing the coal, measuring the boiler-feed water, determining the flow of steam, sampling the gases of combustion, recording the temperature of the water entering the boiler, measuring and recording the draft in the ashpit and in the chimney and measuring the many other quantities that

TEMPERATURE PENDANT.

enable a steam-plant engineer to compare his plant intelligently with other plants of the same class and to determine the magnitude of losses and the possibilities of improvement.

In the operation of a steam boiler, one of the most important quantities is the temperature of the gases passing to the chimney, since, other things being equivalent, this temperature is a direct measure of the portion of the heat of the fuel which is wasted or not utilized.

Indicating and recording thermometers and pyrometers are sometimes put in for measuring the temperature of flue gases. There is a demand, however, for cheap and efficient means of determining flue-gas temperatures which the Green Fuel Economizer Company of Matteawan, N. Y., has met by devising the temperature pendant shown herewith. These pendants consist, as may be surmised, of fusible alloys of the proper composition to indicate the desired temperatures.

It is an interesting fact that the melting points of such metals were found to be too uncertain and evasive to be used as temperature tests. That is, it is difficult to tell the exact point at which the metal melts, since it does not change suddenly from a hard solid to a liquid, as does water, but goes through an intermediate softening stage similar to iron and many other substances. The Green Fuel Economizer Company, therefore, devised the expedient of using the tensile strength of the metal, instead of the melting point, as the true indication of temperature.

In actual use the pendants are hung upon a small hook made upon the end of a long wire, which is introduced into the flue so that the pendant will be at the desired point. The best way is to begin with the lowest temperature pendant and proceed until the one is found which will not fall off after five or ten minutes exposure. The temperature will then lie somewhere between the temperature marked on the last pendant and the next to the last pendant used. In doing this, it is quite essential that several different points in the flue be tried.

New Cutler-Hammer Canopy Switches.

The first canopy switches made by the Cutler-Hammer Manufacturing Company of Milwaukee had split porcelain bodies. Since then the company

No. 7155 SWITCH.

No. 7151 SWITCH.

has developed a fireproof and waterproof insulating material which is used for the bodies of the new switches. This material can be molded with unusual accuracy. It is tough and at the same time also insures permanent alinement of the operating parts.

No. 7155 switch illustrated herewith is said to be entirely new in design. In this switch the push button is replaced by a threaded stem. The switch has been developed to be installed in the bottom shell of ceiling fixtures. The operation is by means of pushing and pulling the bottom knob of the fixture which is screwed onto the threaded stem of the switch. The appearance of the fixture is unchanged and wiring to a wall switch is eliminated.

In the large twelve-story Lowry Building, just finished in St. Paul, Minn., 1,500 of the new Cutler-Hammer canopy switches were installed.

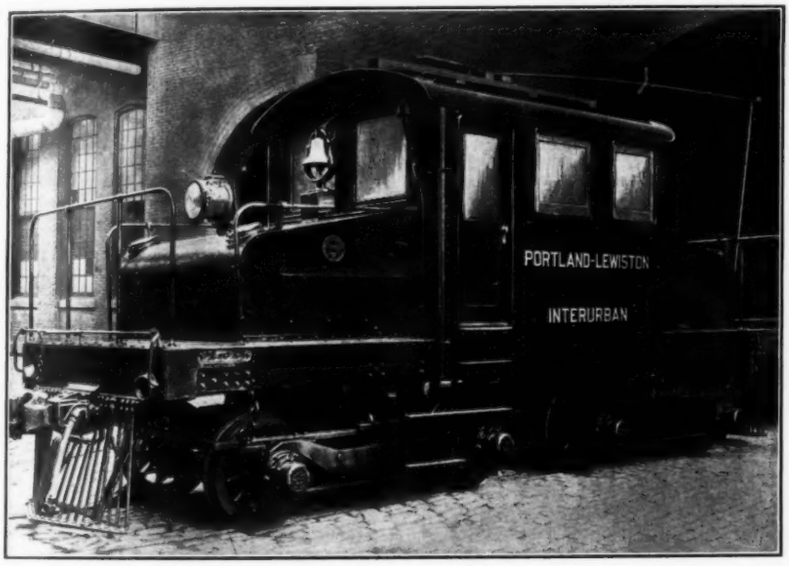
Portland, Grey & Lewiston Railway Company's Electric Locomotive.

A Baldwin-Westinghouse electric locomotive was recently purchased by the Portland, Grey & Lewiston Railway Company. The locomotive is designated by the Baldwin Company as one of Class 8 4/100, E 9. This classification indicates that there are eight wheels total and four motors per locomotive. E is a classification letter used by the Baldwin Works denoting the number of driving axles. One hundred stands for the horsepower of the motors, and the 9 means that it is the ninth locomotive built of its class.

Four No. 303 a Westinghouse motors with a gear ratio of 16 to 61 drive the locomotive and are controlled by a Westinghouse HL control equipment. A feature of HL control that was one of the determining factors in its adoption for this application is the incorporation of an ideal circuit-breaking device in the control equipment. The line switch performs the functions of a circuit-breaker. The switch is controlled by a relay which operates whenever the current to the motors exceeds a predetermined value.

There are several breaks in series and the arcing effect is distributed among them all providing an effective breaking distance of several inches. This control has proven very satisfactory on a number of locomotives. One of these is that operated by the Hoboken Shore Railroad which has had an HL control equipment in service for several years on a switching locomotive. It has given perfect satisfaction and the maintenance cost has been low.

The Portland, Grey & Lewiston locomotive is equipped with hand brakes and also with Westinghouse straight and automatic air brakes. It has a pilot at each end and switching steps, and is equipped with M. C. B. automatic bumpers and couplers. The average number of cars to be handled in a train will be five, and the average weight of a loaded car will be 38 to 40 tons. The total length of the road is thirty-five miles.



LOCOMOTIVE FOR PORTLAND, GREY & LEWISTON RAILWAY.

Speed Variation of Small Turbines.

The Terry Steam Turbine Company reports some interesting results from tests made under government inspection on its turbines, and perhaps the most interesting point of the same is found in the regulation that is obtained with its direct-connected governor that is on the end of the shaft. In the majority of small turbines the geared type of governor is used, but it is readily seen that the direct-connected governor is more sensitive and in close regulation leaves nothing to be desired.

On a turbo-blower set the speed-regulation test showed a speed regulation as follows:

No blower load, 2,490 revolutions per minute.

Full load, thrown on momentarily, 2,400 revolutions per minute.

Full load, settled, 2,460 revolutions per minute.

Thus it will be seen there was a momentary speed drop of 3.6 per cent and a settled drop of only 1.2 per cent.

With the full load on the blower and the gate suddenly closed, the following results were obtained:

Full load, 2,460 revolutions per minute.

No blower load, momentary, 2,575 revolutions per minute.

No blower load, settled, 2,490 revolutions per minute.

This shows a momentary jump of 4.7 per cent and a settled increase of 1.2 per cent.

The results with a five-kilowatt turbo-generator set for the United States torpedo-boat destroyer *Fanning* are given in the accompanying table. It will be seen that the settled speed variation under normal conditions was only 0.79 per cent, while the guarantee was 3.50 per cent. The water rates are in pounds per kilowatt-hour.

TESTS OF 5-KILOWATT TERRY TURBO-GENERATING SET.

	Guaranteed.	Results of Test.
Steam pressure in pounds per square inch	200	187.6
Quality	1.00	0.982
Vacuum in inches	25-28	27.
Revolutions per minute	3800	3820
33.3-per-cent overload water rate		60.4
33.3-per-cent overload water rate (corrected to saturated steam at 200 pounds)	78.	58.5
Full-load water rate		60.6
Full-load water rate (corrected to saturated steam at 200 pounds)	62.	58.8
¾-load water rate (corrected)	71.	60.6
Half-load water rate (corrected)	81.	66.35
Maximum momentary speed variation in per cent (load thrown off)		2.11
Settled speed variation—normal conditions	3.50	0.79
Maximum jump in volts (load thrown off)	18.75	5.6
Maximum temperature rise—Full load	40.	31.
Maximum temperature rise—33.3-per-cent overload	60.	41.
Volts variation — compounding test	2.5	2.4
Overspeed trip — in per cent above normal	10.0	5.94

Rockford Electric Show.

In conjunction with the convention of the Illinois State Electric Association there was held in the Rockford Armory an electric show at which comprehensive exhibits were maintained by a number of manufacturers. The public was invited to attend during the afternoons and evenings, and, judging from the manner in which the invitation was accepted, the exhibition did much toward furthering the application of electricity in Rockford.

The armory was attractively decorated with flags and buntings, and this scheme was carried out in each individual booth. Arc and high-candle power Mazda lamps furnished the illumination. All electrical wiring was done by the E. F. Prendergast Company, electrical contractors.

The Rockford Electric Company maintained an educational exhibit showing the operation of the excess indicator, the relative consumption of carbon and tungsten-filament lamps and numerous household appliances.

Atlas Railway Supply Company exhibited railjoints, braces and tie plates. The Company was represented by G. M. Huber.

Atwood Vacuum Cleaner Company of Rockford, showed in operation three different types of electric vacuum-cleaning plants. The company was represented by J. T. Atwood and S. B. Atwood.

Central Electric Company displayed a complete line of Okonite specialties; Pelouze heating apparatus, including irons and toasters; Pittsburgh high-voltage insulators; Fort Wayne switchboards and portable instruments; Opalux shades; Columbia Mazda drawn-wire-type lamps; Maxolite reflectors; Wasson reels and Central Electric time switches, knife switches, protective devices and vibrators. The company was represented by C. A. Felker and Louis Privat.

Continental Electric Company exhibited a full line of the products of the Campbell Electric Company, including time switches and low-voltage transformers; Crantz Manufacturing Company's switchboards, switches, panel boards; and the Detroit Fuse & Manufacturing Company's iron-clad switches and inclosed fuses. The company was represented by Samuel Faris.

Crouse-Hinds Company showed condulets, panel boards, knife switches, arc and incandescent head lights, and miscellaneous railway material. The company was represented by George A. Gray.

The Dayton Moneyweight Scale Company exhibited two electrically lighted scales for retail merchants.

The Dearborn Drug & Chemical Works maintained reception quarters for visitors and distributed literature bearing on its products.

The Electric Apliance Company showed a complete line of Sangamo meters, Adams-Bagnall ABolites and fans and A-W regulators. F. W. Greusel, H. M. Remington, W. R. Collins, C. G. Flatt, and F. J. Alderson were in attendance

The Electric Service Supplies Company exhibited Adams-Bagnall ABolites, Jandus fans, Garton-Daniels lightning arresters, Crouse-Hinds headlights and railway supplies. Those in attendance were Fred H. Jamison and Thomas Hinkle, with C. W. Beach representing the Adams-Bagnall Electric Company.

Fort Wayne Electric Works of the General Electric Company exhibited lighting and bell-ringing transformers, compensarcs, polyphase and single-phase meters and a complete line of small power motors. The company was represented by A. J. Francis and L. A. Carr.

General Electric Company exhibited a complete line of domestic appliances, including heating devices, cooking devices, fans, small motors and lamps. Those in attendance were W. H. Coleman, S. F. Dibble, Fred Benson, F. J. Shelton, J. A. Nicholson, J. D. A. Cross, J. C. Wilms, J. L. Buchanan, F. Constable, J. Stephens, J. A. Andrews, E. P. Edwards and G. Hutchinson.

The Holophane Company had on display various types of glass and steel reflectors, shades, fixtures and globes. The company was represented by J. W. Foster and B. B. Bownton. The Buckeye Electric Company's lamps were used in this exhibit. F. Irwin and D. H. Wyre represented this company.

Judd Laundry Machine Company had on exhibition two electric washing machines of family size, which were shown in operation. G. M. Judd and A. R. Goddard were in attendance.

The H. W. Johns-Manville Company exhibited J. M. Linolite system of illumination, this being demonstrated in a show window borrowed from one of the local department stores containing goods of various colors; Noarc fuse, service and subway boxes, Noarc inclosed fuses for all voltages up to and including 22,000; J. M. molded fiber conduit in all shapes; J. M. friction and rubber tape; electric heating pads; soldering paste; packings; roofings and miscellaneous asbestos material. H. M. Frantz, M. Clute and C. L. Johnson were in attendance.

Machado & Roller exhibited a complete line of Roller-Smith circuit-breakers and instruments, and Columbia meters of the alternating-current and direct-current rotating standard types. The company was represented by William H. Sinks and Elmer E. Johnson.

Minerallac Electric Company had on exhibition Printometers; maxicators; high-tension insulating compounds and tapes, cable hangers, voltmeter switches and cable-testing sets. The company was represented by H. S. Sines and C. C. Lovejoy.

Westinghouse Electric & Manufacturing Company showed a full line of heating and cooking appliances, fan motors, sewing-machine motors, small power motors; a full line of lamps from the five-watt, wire-type tungsten sign lamp to the 500-watt size; portable testing instruments; wattmeters; graphic recording instruments; mercury rectifiers for battery charging; a new single-phase motor; and a new steel frame interpole direct-current motor. Those in attendance were W. R. Pinckard, R. H. Moore, Arthur J. Cole, J. W. Bush, C. I. Weaver, W. J. Kyle, F. O. Creager, F. E. Servis, C. A. Wood, Stephen Gardner, W. B. Miser, J. B. Stewart and W. A. Thomas.

The Sperry Gyroscope Compass.

The development of the gyroscopic compass so that it has reached the stage of commercial practicability gives promise of a remarkable step in advance in securing an accurate and reliable compass, that will enable courses to be steered with precision and bearings taken accurately while ship is swinging, as well as when she is on her course, and will permit these bearings to be immediately plotted, without loss of time or opportunity for misapplying corrections.

The principle of the gyroscopic compass is as follows. A gyroscopic set rotating and freely suspended will eventually take a steady position of equilibrium with its axis parallel to the axis of the earth, and its direction of rotation the same as that of the earth. This can be shown by taking a small toy gyroscope and, while it is spinning, moving it in a circular path. The axis of the gyroscope will take a position in the meridian with reference to the circular path in which it is moved, and if the motion is reversed it will immediately tumble and thus make its direction of rotation that of the movement to which it is subjected. A gyroscope once in the meridian will resist any force tending to move it out of this position, the resistance increasing with the size of the gyro and the speed of the revolution. Thus any gyroscope of sufficient size and speed of revolution might be used as a compass. The larger the gyroscope and the greater its speed of revolution, the more directive force will such a gyroscope possess.

The apparatus consists of a master compass, repeating compasses, the motor-generator and switchboard. The gyroscope is driven by an alternating-current motor which is included in the gyroscope case. This gyroscope is well protected by its case and is suspended by a piece of pianoforte wire. The gyroscope is operated at a speed of 8000 revolutions per minute. It carries a pointer and contact-maker which moves over a contact circle; and as the heading changes, the contact circle moves over this pointer and contact-maker and this brings into operation the azimuth motor, which brings the compass around to correspond to the position of the gyroscope. It is really only an electric follow-up gear.

The contact circle, compass circle, etc., are carried in gimbel rings, and the apparatus is suspended by springs from some part of the ship's structure. The only force exerted by the gyroscope is to move the contact-maker, and this force is practically nil, and there is thus no tendency for the compass to lag, and the compass is sensitive to even very small changes in heading. There is a correction made for the speed of the vessel. This correction is very small and only amounts to about two degrees for a difference of thirty knots. The speed correction is made by means of a cam which slightly changes the position of the compass circle. The adjustment is made by moving a pointer over a dial.

The heading by master compass is communicated to the repeating compasses by an electric apparatus; the connection being made at the edge of the compass circle, and it is put into operation as the heading changes. The exact heading of the master compass is by this apparatus given to the compass card of the repeater compass. Repeating compasses are connected by means of a two-wire cable, and as many repeating compasses as may be deemed desirable can be connected.

For furnishing the current for the motor and alternator, there is a motor-generator set, mounted on a common base, and this with a small switchboard completes the apparatus.

Current Electrical News

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

At a hearing before the Public Service Commission, First District, October 23, on the complaint of George Stadtlander and others against the New York Edison Company, on the rates charged for electricity in Manhattan and the Bronx, five bodies of stationary engineers appeared to verify the complaint that the rates charged by the Edison Company were discriminatory, in that many large concerns were given rates far below the cost of production of the current, in order to cut out smaller producers. Henry J. Hemmens, counsel for the Edison Company, contended that twenty-two of the original complainants were not on the books of the company as consumers of electricity. The hearing was adjourned until November 1, when further evidence was produced.

The resolution submitted to the Public Service Commission, First District, by Commissioner Cram, granting the application of the Dry Dock, East Broadway & Battery Railroad Company, Frederick W. Whitridge, receiver, for authority to use storage battery cars on its various lines, was taken up and after some discussion action was deferred indefinitely by the Commission.

A summary of the sales of tickets in the subway for the year ended June 30, 1911, prepared by Dr. A. F. Weber, chief statistician of the Public Service Commission, has been given out. The total sales for the year were 276,704,796, an increase over the previous year of 7,742,681. The increase was marked in The Bronx, and also in Brooklyn, but many of the stations in Manhattan showed an actual decrease. The average daily sale throughout the year, counting Sunday as only half a day, was 813,837, against 791,065 the year before, and 701,265 for the year ended June 30, 1909.

E. G. Connette, transportation engineer of the Public Service Commission, said at the final hearing on the proposed increase of elevated trains from seven to eight cars during the rush hours that in his opinion the cost to the Interborough Company, exclusive of damages to property owners for lengthened stations and the burden of increased equipment, would be $2,000,000. In this he took issue with Frank Hedley, vice-president and general manager of the Interborough, who had testified that the cost would be $10,000,000, and had declared that he would not assume responsibility for operating eight-car trains without reinforcement of the elevated structures. The main expense, according to Mr. Connette, would be the strengthening of draw-bars and couplings, which he put at $1,260,000, and he estimated that it would cost another $250,000 to lengthen and widen the stations.

The Public Service Commission for the Second District has ordered all operating electrical corporations within its jurisdiction to file information as to the electric meters which measure their output of electric energy. The information includes an estimate of the connected load of each company in kilowatts and of the total generating capacity of the various plants. The purpose of this order is to ascertain how completely the electrical companies are equipped with respect to instruments for measuring their power output.

At Mineola on Friday the complaint of patrons of the Nassau Light & Power Company as to the rates charged for electricity for lighting purposes was heard.

LIGHTING AND POWER.

(Special Correspondence.)

GLENCOE, IOWA.—The installation of boulevard electric lights is being agitated. C.

SULTANA, WASH.—An electric light system for the town is now being installed.

EUGENE, ORE.—The City Council has authorized the sale of $25,000 electric light bonds.

POCAHONTAS, IOWA.—Bonds for the installation of electric lights have been approved by the buyers. C.

STILLWELL, OKLA.—The electric light and water plant has been completed. Service is very satisfactory.

CLARION, IOWA.—The Council let the contract for the installation of thirty-one electroliers in the town. C.

PHILIP, S. D.—F. E. Morrison will equip his power plant with a view to supplying the town with electric light. C.

MENDON, MICH.—This town has made arrangements to purchase power from the new municipal dam at Sturgis.

PILOT MOUNT, IOWA.—It has been voted to grant a franchise for the installation of an electric light and power plant. C.

FOND DU LAC, WIS.—The Central Construction Company has the contract to install fourteen ornamental cluster lights. C.

FULLERTON, CAL.—The city has signed a five-year contract with the Southern California Edison Company for an improved street lighting system, which will be installed at once.

HARLINGER, TEX.—This city has voted $32,000 of light, water and street-improvement bonds.

LIVERMORE, CAL.—The Livermore Water & Power Company is preparing to extend its electric lines to Sunol from Pleasanton.

COLTON, CAL.—The Southern California Edison Company has been awarded the contract for a street lighting system for this city.

ALHAMBRA, CAL.—The Board of Trustees is planning for the installation of an ornamental street-lighting system, with concrete posts. A.

PROSSER, WASH.—The Pacific Power & Light Company has applied for a fifty-year franchise for a transmission line within the county.

MIAMI, ARIZ.—The Miami Electric & Power Company has been incorporated with a capital of $500,000 by C. W., R. S., and L. D. Van Dyke. A.

COLUMBUS JUNCTION, IOWA.—E. N. Miller, of Greeley, Colo., and R. D. Parks, of Kansas City, have plans for the installation of electric lights. C.

TROPICO, CAL.—The Glendale Light & Power Company has submitted to the Board of Trustees a proposition for a street lighting system for this town.

VISALIA, CAL.—Application has been made to the Board of Supervisors for a thirty-year franchise for a transmission line on the public highways of this county.

BOUTON, IOWA.—The Opera House & Power Company has authorized the purchase of machinery for the electric light plant, including a nine-kilowatt dynamo. C.

SAN JOSE, CAL.—The Sierra & San Francisco Power Company has asked permission of the Common Council to install wires for will install a hydroelectric power house.

LOS ANGELES, CAL.—The Sunset Beach Gas & Electric Company has been incorporated by C. W. Gower, F. W. Norman and H. Pierce, with capital stock of $25,000.

BRIGHTON, IOWA.—L. Whitney, of Mount Pleasant, and L. J. Highland, of Burlington, have secured the Brighton mill dam and will install a hydroelectric power house. C.

NOGALES, MEX.—C. W. Phillips and associates will install a hydroelectric plant near their Penn-Sonora gold mines near Nogales and will put in other machinery. D.

UNION CITY, MICH.—The old arc lighting here has now been supplemented by the use of Tungsten lamps. Several thousand dollars has been invested in new electrical machinery.

MIDLAND, TEX.—The City Council has contracted with the Midland Light Company for the installation of a number of additional lights. The plant of the company will be improved. D.

STOCKTON, CAL.—The Sierra & San Francisco Power Company has entered the local field and proposes to spend about $200,000 in Stockton. An auxiliary plant will be built in this city.

KENEDY, TEX.—The Kenedy Light & Power Company is installing an electric light plant here. The plant will be so arranged that its capacity may be easily increased when the demand becomes larger. D.

BEDFORD, IOWA.—The contract has been let to the Lee Electric Company, of Clarinda, Iowa, to supply the city with electric light. An extension of fifteen miles from New Market will be constructed.

LOS ANGELES, CAL.—The Los Angeles Brass Manufacturing Company has been awarded the contract for the 171 ornamental bronze lighting posts to be used on South Orange Avenue, Pasadena, Cal.

EUREKA, CAL.—The Minor Mill Lumber Company, which has owned and operated the Blue Lake Light & Power plant for a number of years, has sold this plant to the Western States Gas & Electric Company.

MULDROW, OKLA.—The Board of Trustees has accepted the bid of F. R. Stone, of Lima, O., to install a municipal electric light plant and water works. The cost will be $26,760. Bonds have already been voted.

EVANSVILLE, IND.—The Central Gas & Power Company was recently incorporated with a capital stock of $10,000 to distribute electrical energy. The incorporators are P. J. Scheller, Henry Dannettell and H. J. Peckinpaugh.

SIERRA CITY, CAL.—The Sierra Buttes Mines Company plans

for the erection of two hydroelectric power plants for mine operation, on the Sardine series of lakes in this district. The total capacity will be about 20,000 horsepower. A.

LIBBY, MONT.—Work will be started at once on the construction of a power plant at Yakt Falls, twenty miles northwest of here, to develop 3,400 horsepower. C.

RED LAKE FALLS, MINN.—The United States geological survey has completed the survey of Red Lake River, with a view to the construction of dams to maintain an even flow in that river. Joseph Perrault, city clerk, will receive proposals up to 8:30 p. m. November 9 for granting an electric light and power franchise. C.

THE DALLES, ORE.—The Pacific Power & Light Company will build a new transmission line between The Dales and Wallula, a distance of about one hundred and thirty miles. The line will carry a voltage of 66,000 volts, and is estimated to cost $400,000. A.

STOCKTON, CAL.—The San Francisco & Sierra Power Company has been granted a franchise along the county roads from Menteca to Stockton and the company announces that within sixty days electricity will be furnished to consumers in that section.

KOKOMO, IND.—The stockholders of the Kokomo Electric Company have increased the capital stock from $25,000 to $150,000. Chas. T. Byrne is president and J. P. Grace secretary. The increased capital is made necessary to enlarge the plant and the company's business. S.

INDIANAPOLIS, IND.—The Central Indiana Water, Light, Heat & Power Company, of Francesville, has been incorporated with a capital stock of $125,000 to supply Francesville and nearby cities and towns. The directors are E. A. Rossiter, Hazel Keenon, Edward Smalley, Charles Lohrer and A. J. Cooper.

MOUNTAIN HOME, IDAHO.—Smith, Kerry & Chace Company, Portland, has commenced the erection of a 14,000-horsepower hydroelectric power plant on the Snake River, near Mountainhome. A transmission and distributing system will be installed for a distance of about sixty miles, for pumping operations. A.

FT. WAYNE, IND.—The Kehoe Light & Power Company has filed articles of incorporation with a capital stock of $100,000. This public service corporation proposes to furnish light, heat and power to the inhabitants of Ft. Wayne and vicinity. The directors are: T. J. Kehoe, C. M. Neizer, C. M. Riedel and T. R. J. Wolf. S.

ANDERSON, S. C.—The Savannah River Power Company, capitalized at $1,000,000 and owning the Gregg Shoals & Cherokee Falls Power Plant, has been purchased by the Georgia Railway & Power Company of Atlanta. The Gregg plant now furnishes lighting for the cities of Abbeville and Greenwood, and operates several cotton mills.

FRANCISVILLE, IND.—The Central Indiana Water, Light, Heat & Power Company, recently incorporated with a capital stock of $125,000, is in the market for material, machinery and expert labor to construct and equip a public service plant to furnish water, light, heat and power to this and nearby towns and cities. Edgar A. Rossiter is president. S.

SOUTH BEND, IND.—The School Board of South Bend has decided to install an electric generating plant in the new $300,000 high school building now in course of erection. The board is now asking for rates for the installation of such plant since it is an entirely separate matter from the original contract. George Knoblock is president of the Board. S.

MARTINSVILLE, IND.—The Street Lighting Committee has rejected all bids on the proposed new lighting plant and decided to go into the market and purchase materials direct. The committee is of the opinion that by so doing they will save enough to buy an alternating-current generator to run the decorative lights in case they should put them in. They will also purchase ornamental posts and lamps. S.

FREMONT, O.—A resolution has been passed by the City Council authorizing the service director to receive bids for the new electric lighting contracts for the city involving an expenditure of about $150,000 and to run for ten years. The bids will be opened on November 21. The contracts formerly held by the Fremont Yaryan Company has expired and plans and specifications for the new contracts were prepared by Mr. Froehlich, a Toledo electrical expert. H.

PHOENIX, ARIZ.—The Salt River Valley Water Users' Association has awarded a contract to the Olsen-Graf Company, at $22,-922, for the erection of powerhouse No. 2, on the South Consolidated Canal. Contracts have also been awarded as follows: Wagner Electric Company, transformers; Allis-Chalmers Company, air compressor; Minneapolis Steel & Machinery Company, double gates, and other iron work; Arizona Electric Company, wire, conduit, electric appliances. A.

MINNEAPOLIS, MINN.—Preliminary work has been started on the power dam of the Great Northern Development Company at Coon Creek, ten miles up the Mississippi River from Minneapolis. Contracts for grading an embankment on the east side of the river have been let and C. C. Cokefair, of Duluth, president of the company, states that the dam will be completed within twelve months and that the company can develop 15,000 horsepower at the Coon Creek property.

ALVIN, TEX.—The Alvin Water, Light & Ice Company and the Alvin Ice, Light & Power Company, two separate operating companies, have been consolidated under the name of the Alvin Electric Company. A charter for a new company with a capital of $40,000 has been been applied for. The directors elected for the first year are J. A. Cook, M. S. French, P. H. Monaker, C. Z. Sedwick, W. R. Stockwell, W. C. Hunt and S. O. Smith The officers will be elected at a later meeting of the directors.

SAN BERNARDINO, CAL.—A trust deed has been filed in the County Recorder's office here by the Southern Sierras Power Company conveying to the International Trust Company the property of the power company to secure an issue of first mortgage bonds to the amount of $5,000,000. The company has let a contract to the C. C. More Company of San Francisco, for the erection of the company's central power plant at this place. A contract has also been let in Los Angeles for the construction of about sixty miles of power line in San Bernardino and Riverside Counties to be completed in ninety days.

WATERVILLE, ME.—The transfer of the Waterville & Fairfield Railway & Light Company to the Central Maine Power Company is announced. The property involved includes the Waterville & Fairfield, Waterville & Oakland electric roads, several power stations, valuable water power rights and the general lighting and power business in this city and vicinity. The purchase gives the Central Maine Company 8,000 hydraulic horsepower and 5,000 steam horsepower and the control of the electrical business of Central Maine from Bingham to Richmond on the Kennebec River and of the water supply of the Belgrade Lakes system. The two companies have been competitors in this section for several years.

SAN ANTONIO, TEX.—The Medina Irrigation Company, which is constructing a dam and irrigation system near here at a cost of about $6,000,000, will also erect large cotton mills and oil mills and other industrial plants which will utilize the products that are to be grown upon the land that is to be reclaimed. The main dam will be 170 feet high, 107 feet thick at the base, about 50 feet wide at the top and 1,500 feet long. Below this main dam there will be constructed a second reservoir to be created by the building of another dam 40 feet high and about 1,000 feet long. The plans for the hydroelectric plant that is to be installed and operated in connection with this irrigation system are being prepared. The construction of an electric interurban railway to run from San Antonio through the irrigated property and intermediate towns will be started in a short time, it is stated. The Medina Irrigation Company is one of the several projects of Dr. F. S. Pearson, of New York. D.

ELECTRIC RAILWAYS.

(Special Correspondence.)

GRISWOLD, IOWA.—The contract has been let to J. W. Daily to build an electric line to Elliot. C.

TRAIL, B. C.—The Canadian Pacific Railway is planning to electrify its system from Trail to Rossland, B. C. A.

COFFEYVILLE, KANS.—The Union Traction Company will build an extension from this point to Parsons, Kans.

DEVILS LAKE, N. D.—The Stetler Investment Company has bought the Chautauqua electric railway, and will equip it for operation. C.

FERGUS FALLS, MINN.—S. O. Bridston, Nels Haagenson and U. A. Huss have petitioned the Council for a franchise to build a street car line. C.

OMAHA, NEB.—The Omaha, Sioux City & Northern Railroad Company is planning the construction of an interurban line to Dakota City, Neb.

WORTHINGTON, MINN.—G. E. Doyle, of East Chain, and H. W. Knight, of Chicago, promoters of the new electric line, have secured the right of way to Pilot Grove. C.

FRESNO, CAL.—J. C. Forkner, and associates, plan for the construction of an electric railway from Fresno to the San Joaquin River, passing through the Bullard Tract. A.

ABERDEEN, WASH.—The Grays Harbor Railway & Light Company has been granted a franchise by the City Council, to make extensions in its local electric railway lines. A.

PACIFIC GROVE, CAL.—The Monterey & Del Monte Heights Railway is to be completed at once, and cars will be running to Del Monte Heights by the middle of December.

VIRGINIA, MINN.—Early next spring the Mesaba Railway Company expects to commence the construction of forty-four miles of electric railway, connecting Virginia with the range towns. C.

WHITE SALMON, WASH.—Bertleson & Sons, Tacoma, contractors, have submitted a bid to the Mt. Adams Electric Railway Company to construct its proposed line from a point near the Columbia River to White Salmon, about two miles, for $42,000. A.

VANCOUVER, B. C.—The Canadian Pacific Railway has acquired a power site on the Adams River, and is said to be planning for the erection of a large hydroelectric power plant. The company will electrify a section of its system in this vicinity. A.

ATLANTA, GA.—A charter has been granted to the Georgia Railway & Power Company by Secretary of State Philip Cook. This is the company which, with a capitalization of $27,000,000, is to take over the Georgia Railway & Electric Company, of this city.

and all of the hydroelectric plants in the north and northeastern sections of the State. The charter is to run for 101 years. C. Elmer Smith, of York, Pa., is to be president of the company.

OAKLAND, CAL.—The Sacramento Short Line and the San Jose Short Line have been incorporated by B. M. Aikens, R. P. Henshall, Luther Elkins, G. M. Mordecai, N. Schmulowitz, R. V. Whiting and F. L. Stewart, the former for $10,000,000, and the latter for $9,000,000.

MONTEREY, MEX.—The Monterey Electric Tramways Company is preparing to make important extensions of its system. One of its lines will be extended to the suburb of Gonzalitos, a distance of three miles. The other extensions will be run to new residence sections that are being opened up. D.

GARY, IND.—Financial arrangements have been made which assure the early completion of the Gary-Hobart Electric Railway, and it is expected that cars will be running by January 1. The Gary Trust & Savings Bank has taken the bonds which will provide for sufficient finance to put the road in operation. S.

TERRE HAUTE, IND.—The officials of the Terre Haute, Indianapolis & Eastern Traction Company have let a contract to the Bedford Stone & Construction Company for the construction of a new traction and terminal station in this city. The building will be commodious and modern in every particular and will include an arcade running through the entire plan. D. H. Burnham & Company of Chicago are the architects. The structure will be erected on Wabash Avenue and will be known as the Terminal Place. S.

TOLEDO, O.—A movement is on foot for the reorganization of the Toledo, Ann Arbor & Detroit, an electric line projected and partly built several years ago between Toledo and Ann Arbor, Mich. The company has met with many reverses, including a receivership, and work has been at a standstill for many months. More than $500,000 has already been expended on construction. The grading was about completed three years ago and nearly twenty miles of the track has been laid. It is announced that the work will now be completed within a few months. H.

DALLAS, TEX.—The Board of Municipal Commissioners has granted the Dallas Southern Traction Company right of way for its proposed interurban electric line over Zang's Boulevard from the southern limits of the city to a junction at Jefferson Street with the line of the Northern Texas Traction Company. The company has a contract with the latter company and the Rapid Transit Railway Company for the use of their Jefferson Street and Commerce Street tracks. This company is constructing interurban railway to Waxahachie. It is one of the projects of the Stone & Webster Engineering Corporation. D.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

PEQUOT, MINN.—The Pine River Telephone Company will build a joint line between Jenkins and Pequot. C.

RIALTO, CAL.—The Home Telephone Company will build a new exchange on Riverside Avenue. A.

STEELE, N. D.—The County Board granted a franchise to the Farmers Telephone Company, of Dawson, to operate a telephone line. C.

PIERZ, MINN.—John Stroming, of Swanville, has purchased the P. M. Blake private telephone line to Lastrup, and will extend it fifteen miles. C.

SHELDON, N. D.—The Helendale Rural Telephone Company has been formed and will build a line from Leonard to the Power bridge. D. G. Radcliffe is secretary. C.

REEDLEY, CAL.—T. M. Lane and Lucas Keyser will organize a co-operative telephone company at Reedley. The new organization will endeavor to purchase the present telephone system, or will install an entirely new system. A

BAKERSFIELD, CAL.—The Lost Hills Telephone & Telegraph Company will make additions and improvements in its telephone system in the Lost Hills district. The work is estimated to cost $25,000. Richard Hastings is manager. A.

MISSOULA, MONT.—A. H. Stephen, V. H. Calhoun and F. C. Wilhelm incorporated the Flathead Independent Telephone Company, capital $50,000, to construct telephone lines in Missoula, Ravalli, Sanders and Flathead Counties.

RED BLUFF, CAL.—The Tehama County Telephone Company has acquired the Red Bluff-Paskenta Telephone Company. The system comprises a teritory of about fifty miles of lines, and will be added to the general exchange of the purchasing company. A.

FOSTORIA, O.—The new telephone systems for dispatching trains on the Toledo & Ohio Central Railway has been completed between Thurston and Bucyrus and is now in operation. It is expected that the lines will be completed and the system ready for use as far as this city within a few days. H.

WOODBURN, ORE.—The Northwestern Long-Distance Telephone Company has taken over the local telephone system which was formerly owned by Henry Chappelle. The company has also bought the United Telephone Company, which owns and operates an extensive system, including Canby, Aurora, Hubbard, Macksburg, Needy, Gervais and St. Paul, in addition to the lines in this city.

ELECTRICAL SECURITIES.

Proposals will be received at any time by Perry, Houston County, Ga., for $6,000 ten-year five per cent electric light bonds.

There has been listed on the Philadelphia Stock Exchange $486,000 additional first mortgage and collateral trust five per cent gold bonds of the Philadelphia Company.

Subscription receipts of new Commonwealth Edison stock, amounting to $4,950,000, have been admitted to the unlisted department of the Chicago Stock Exchange.

Stone & Webster offer at 93.5 (to yield about 6.4 per cent) $300,000 six per cent cumulative preferred stock of the Galvston-Houston Electric Company. Proceeds will be used for extensions and improvements to the property made necessary by increasing business.

Boettcher, Porter & Company of Denver, are offering, at 105, Mountain States Telephone & Telegraph Company's seven per cent stock.

A special meeting of the stockholders of the Detroit Edison Company will be held on November 15 to vote upon proposal to increase the capital stock from $9,000,000 to $15,000,000. It is proposed to issue at an early date, $1,500,000 of the new stock which will be offered to stockholders, pro rata, for subscription at par. Directors will be authorized to issue the increased stock from time to time in such a manner as they may deem advisable. For the meeting books will close November 4 and reopen November 16. The additional capital will be used to provide funds for extensions and additions to the company's plants and property. The present authorized capital stock of the company is $9,000,000, of which $6,000,000 is outstanding and $3,000,000 is reserved against a like amount of outstanding convertible debenture bonds. Formal notice has been received by the New York Stock Exchange of the proposed increase by the Detroit Edison Company.

DIVIDENDS.

Cape Breton Electric Company, Limited, semiannual dividend of $3.00 a share on preferred stock, payable November 1; also a dividend of $2.00 a share on the common, payable November 1.

Detroit United Railway; regular quarterly dividend of one and one-quarter per cent payable December 1 to stock of record November 15.

Fort Worth (Texas) Power & Light Company, an initial quarterly dividend of one and three-quarters per cent on the cumulative preferred stock, payable November 1 to stockholders of record October 20.

Hartford Electric Light Company; quarterly dividend of two and one-half per cent, payable November 1.

Tampa Electric Company; regular quarterly dividend of $2.00 and $1.00 extra per share on the capital stock, payable November 15.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES IN THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEKS.

NEW YORK.

	Oct. 30.	Oct. 30.
Allis-Chalmers common	2¾	3
Allis-Chalmers preferred	10	11
Amalgamated Copper	52¼	53⅜
American Tel. & Cable	*74	*74
American Tel. & Tel.	134	134⅞
Brooklyn Rapid Transit	73⅞	74½
General Electric	147¼	150
Interborough-Metropolitan common	14½	14⅝
Interborough-Metropolitan preferred	44¼	44
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	84	86
Mackay Companies (Postal Telegraph and Cables) preferred	72½	72⅝
Manhattan Elevated	134	134
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	43½	43
U. S. Steel common	52⅝	59¾
U. S. Steel preferred	104⅛	109½
Western Union	77	78¼
Westinghouse common	63	64½
Westinghouse preferred	*111	111

*Last price quoted.

BOSTON.

	Oct. 30.	Oct. 30.
American Tel. & Tel.	133⅞	134⅝
Edison Electric Illuminating	287	285
General Electric	147¼	150
Massachusetts Electric common	20¾	20⅜
Massachusetts Electric preferred	93	93
New England Telephone	143	145
Western Tel. & Tel. common	26½	26⅝
Western Tel. & Tel. preferred	104¾	105

PHILADELPHIA.

	Oct. 30.	Oct. 30.
American Railways	43¾	44
Electric Company of America	11¾	11¾
Electric Storage Battery common	52	53
Electric Storage Battery preferred	52	53
Philadelphia Electric	16¼	16⅞
Philadelphia Rapid Transit	22¾	23½
Philadelphia Traction	83¾	83¾
Union Traction	50¼	50⅞

CHICAGO.

	Oct. 30.	Oct. 30.
Chicago Elevated common	28	25
Chicago Elevated preferred	93	90
Chicago Railways, Series 1	92	92
Chicago Railways, Series 2	30½	30¼
Chicago Subway	1	⅞
Chicago Telephone	121	121
Commonwealth Edison	129	127¼
National Carbon common	101½	100
National Carbon preferred	118	117

PERSONAL MENTION.

ADDISON L. GARDNER has been appointed general attorney for the Chicago Elevated Railways Company.

SAMUEL N. TAYLOR, formerly professor of electrical engineering in the University of Cincinnati, has been appointed professor of physics in Goucher College, Baltimore, Md.

WILLIAM MARCONI has been at St. Johns, N. F., conducting experiments with the object of ascertaining the advisability of installing a more powerful station on the spot where his first wireless telegraph tests were made.

FRANK F. FOWLE, consulting engineer, Chicago, will present a paper on "Going Value" at the next joint meeting of the Chicago Section, American Institute of Electrical Engineers, and the Electrical Section, Western Society of Engineers. The meeting will be held in the rooms of the latter society in the Monadnock Block, Chicago, on the evening of November 22.

W. H. EISENBEIS, for many years connected with the Westinghouse Electric & Manufacturing Company of Toronto, has severed his connection with that company to go into business for himself in Pittsburgh. Mr. Eisenbeis will long be remembered by engineers in and around Toronto as the secretary of the Toronto branch of the American Institute of Electrical Engineers to which he gave three years of energetic and helpful service.

D. STERRETT PINDELL has been added to the staff of the engineering and construction firm of C. G. Young, 60 Wall Street, New York City. Mr. Pindell has had an unusually broad and valuable experience in a wide range of engineering, construction and operation of public service utilities throughout the United States and Canada including steam and electric railways, electric lighting, hydroelectric power development, building construction, etc. His present activities will be especially in connection with examinations and reports.

DAVID VAN ALSTYNE, vice-president of the Allis-Chalmers Company, and in charge of its manufacturing operations, will sever his connection with that company on November 15. He will move to New York City, where he will engage in professional work as an expert and consulting engineer. Mr. Van Alstyne came to the Allis-Chalmers Company from the vice-presidency of the American Locomotive Company. He enjoys a high reputation in his profession and his resignation came as a surprise to his West Allis associates. C. E. Search, formerly Mr. Van Alstyne's assistant, who has long been an official of the company, has been appointed works manager of the Milwaukee plant to succeed Mr. Van Alstyne.

S. B. WAY, chief electrical engineer of the Union Electric Light & Power Company, St. Louis, Mo., has been promoted to the position of assistant general manager of the Milwaukee Electric Railway & Light Company to have charge of the electric light and power and gas departments as well as the generating departments. He assumed his new duties on November 1. Mr. Way has been chief electrical engineer for the Union Electric Company and Imperial Company for the past thirteen years. Prior to that time he was erecting engineer for the Electric Storage Battery Company of Philadelphia. Before leaving for Milwaukee he was given a dinner by the heads of departments of the company, and a farewell banquet by the employees of his department. Mr. Way has been prominent in St. Louis and will be greatly missed in electrical circles tnere.

OBITUARY.

GEORGE A. DEAL, manager in Providence, R. I., for Henry Clews & Company, New York bankers, died in Providence a short time ago. He was formerly manager of the Postal Telegraph Company in Bridgeport, Conn., and Springfield, Mass.

NEW INCORPORATIONS.

NEW YORK, N. Y.—The Foreign Electrical Supply Company has been incorporated with a capital of $10,000 by Morton Stein, Daniel Stein and Clarence H. Griffith.

NEW YORK, N. Y.—The Busch Storage Battery Company has been incorporated with a capital of $30,000 by Decker, Allen & Storm, Charles Busch, Louis Heering and Oscar E. Noetling.

BUFFALO, N. Y.—The Queen City Electric Automobile Company was recently incorporated by Moses T. Day, A. C. Tonne and C. S. Chamberlain. The company has a capital of $50,000.

TRENTON, N. J.—The Burtis Company has been incorporated with a capital of $125,000 to deal in electric fixtures. The incorporators are J. Woolsey Burtis, Alleyne Burtis and Hervey S. Moore, all of Trenton.

BRAZIL, IND.—The Mullen-Blackledge-Nellis Manufacturing Company announces that prepaartions are being made to install additional electrical and mechanical machinery to their plant to increase its capacity.

NEW YORK, N. Y.—The Electric Ad-Lite Company has been incorporated with a capital of $10,000 by William H. Schnitzer, Joseph G. Kanter, Benjamin F. Kanter and Frank V. Daniels. The concern will manufacture electrical devices.

KENTON, O.—The Kenton Appliance Company which will manufacture gas and electrical appliances has been incorporated with a capital stock of $10,000. The incorporators are Charles R. Price, J. A. Baird, Harry Steffen, W. C. Simmons and C. E. Willeke.

NEW PUBLICATIONS.

STATISTICS OF AUSTRIAN CENTRAL STATIONS.—The Elektrotechnischer Verein, of Vienna, has published a volume with the title "Statistik der Elektrizitätswerke in Osterreich," which contains statistics of date July 1, 1911, of the central stations in Austria and Bosnia-Herzegovina. The total number of these is 800. Full information is given of the place, the electrical installation, the distribution system, the connected load, rates, capital, personnel, etc. The volume conatins 108 pages and the price, bound, is $1.00.

ELECTRICAL ACCIDENTS IN MINES.—The Bureau of Mines, Washington, D. C., has issued a circular entitled "Electrical Accidents in Mines, Their Causes and Prevention," by H. H. Clark. This circular states the chief causes of electrical accidents in mines, points out briefly the precautions that should be taken to avoid accidents, and gives directions for treating persons who have been shocked or burned. A list of "don'ts" for mine foremen, for electricians and for miners are given. A copy of the circular should be in the hands of every miner.

THE INVENTORS' OUTLOOK.—In Washington, D. C., where patent interest of this country is centered—in fact directly across from the United States Patent Office—there have been started publication offices of a magazine which will have the interest of the inventors at heart. As far as possible the contributors to the *Inventors' Outlook* will be inventors, many of whom are well-known writers. The journal will serve as a guide and helper to inventors and will assist in working out the common problems confronting them. It will act as an aid to manufacturers and will make strong efforts to secure better patent laws than are now in force. The first number will appear in November.

TESTS OF NICKEL-STEEL RIVETED JOINTS.—This publication, by Arthur N. Talbot and Herbert F. Moore, has just been issued as Bulletin No. 49 of the Engineering Experiment Station of the University of Illinois. This bulletin describes tests of riveted joints of nickel-steel in tension and in alternated tension and compression. The slip of rivets and the strength of joints were determined. From the tests, the general conclusion is drawn that in riveted joints, designed on the basis of ultimate strength, the use of nickel-steel may be of advantage; but that in riveted joints designed on the basis of frictional hold of rivets, while it may be advantageous to use nickel-steel for the plates, rivets of ordinary steel seem to resist slip as well as rivets of nickel-steel.

LEGAL NOTES.

DUTY TO INSPECT TEMPORARY WIRES.—The Supreme Court of Nevada says that it was not much impressed with the contention that a company was relieved of its legal duty to inspect certain wires because they were temporary. The court rather inclines to the view that the fact of the wires being temporarily strung and not of a permanent nature, and possibly not placed with that care and foresight that they should have been, or would have been, had they been intended for permanent use and permanently placed, would require the company to a more strict and frequent accountability and inspection of the wires than otherwise, before sending an employe to work among the wires so temporarily strung, at the peril of life and limb. Again, the court says that it can see no error in submitting to the jury, as a matter of law, the duty of defendants, owning or controlling an electric wire dangerous to life and limb, of making an inspection as to the safety of such wire. It is both just and right that corporations and individuals dealing in the transmission or having control of wires conducting electricity should be compelled at all times to thoroughly and frequently inspect the wires, to the end that they may at all times, in so far as it is within the reasonable power of man, render them safe and see that they are properly insulated and placed.—Cutler vs. Pittsburg Silver Peak Gold Mining Company, 116 Pac. R. 418.

SENDING CAR OUT WITH DEFECTIVE CONTROLLER.—Early in the morning a motorman was directed by the railway company's dispatcher to take a car, that had a controller on either end, from the barn over a route some seven miles in length. He ran the car several squares, to a point where the track connected with another track which he was to take. He then went to the other end of the car, and when he took hold of the contorller he received a slight electric shock. He informed the conductor of this, and was told by him to go on to a place where he could telephone for another car. As he went on, the condition of the controller became worse, and the shocks more severe. He was, however, able to manage the car without injury until he attempted to stop it to avoid colliding with another car on the same track. When he reversed the controller and applied the brake for that purpose, his arm was burned and he was made unconscious by the electric shock, and in the collision which resulted he was otherwise seriously injured. There was evidence that the company's cars were sent out without inspection, and that the defect in the controller would have been discovered by inspection. In affirming a judgment in favor of the motorman, the Supreme Court of Pennsylvania says that the reasonaole inference was that the controller was defective when it left the barn. This made out a prima facie case of negligence on the part of the company. Whether the motorman was, under the circumstances, negligent in continuing to run the car, was a question for the jury.—Smith vs. Chester Traction Company, 80 Atl. R. 254.

INDUSTRIAL ITEMS.

L'AIR ELECTRIQUE, Paris, France, has issued a folder illustrating a number of types of electric fans, ventilators, etc. A slip is attached on which is printed, in five languages, a request for agents in every country.

THE LEEDS & NORTHRUP COMPANY, Philadelphia, Pa., recently mailed leaflets on the Leeds & Northrup power bridge, the Leeds & Northrup ohmmeter, and the Leeds & Northrup precision potentiometer for use with thermocouples.

THE FEDERAL SIGN SYSTEM (ELECTRIC), Chicago, Ill., describes street lighting in Logansport, Ind., in the October issue of the *Federalist*. A day and night view are given, together with a small illustration of the fixture which is used.

ROTH BROTHERS & COMPANY, Chicago, Ill., manufacturer of motors and generators, has ready for distribution an attractive "Picture Book," containing over forty views of Roth motors applied to various machines. A brief description accompanies each illustration.

THE BELDEN MANUFACTURING COMPANY, Chicago, Ill., lists its electrical wire, cable and cordage in a recent catalog No. 5. The publication is a pocket size and is bound in cloth. The various types of cable, tapes, etc., are illustrated and the prices are given throughout.

THE F. W. WAKEFIELD BRASS COMPANY, Vermilion, O., recently distributed a novel booklet describing its candle fixtures. These are prepared to burn real wax candles and are to be used as a supplement to electric lighting. The publication has been prepared for holiday trade.

THE GOULD STORAGE BATTERY COMPANY, New York, N. Y., explains the economies of the storage battery car in Bulletin No. 13 entitled "Storage Battery Cars." The standard type of cars made by the company are described and the conditions under which they may be used profitably are stated.

HORACE J. STEVENS, Houghton, Mich., publisher of the Copper Handbook, is making an unusual offer in regard to the sale of this book. To any one interested a copy will be mailed, prepaid on one week's approval. After an inspection of the contents the purchaser can return the book or remit the price.

THE BATES MACHINE COMPANY, Joliet, Ill., describes the Bates inertia valve gear in Bulletin No. 36, which has just been distributed. This gear, which is regularly attached to all Bates Corliss engines, has attracted considerable attention because of its positive, quiet operation and the absence of springs, hooks, etc.

THE BEARDSLEE CHANDELIER MANUFACTURING COMPANY, Chicago, Ill., has prepared a catalog of holiday suggestions, in which a number of very attractive art-glass shades are illustrated. This publication has been issued as a preliminary to the holiday season and will be of great value as an aid to the selection of suitable shades for gifts.

H. W. JOHNS-MANVILLE, Cleveland, O., has given special attention to the covering of pipes in the September number of the *J-M Packing Expert*. A full-page illustration of the boiler room of Corrigan, McKinney & Company's furnace is included. All of the high-pressure lines in this installation are covered with J-M asbestos-sponge felted sectional pipe covering.

PETTINGELL-ANDREWS COMPANY, Boston, Mass., illustrates in the October issue of *Juice* a number of portable lamps which are being produced to meet the holiday demand. These selections have been made from a new portable-lamp booklet which is now on the press, and which the company states shows the fastest selling portable-lamp line that it has ever developed.

W. M. MATTHEWS & BROTHER, St. Louis, Mo., are advertising Matthews' O. K. sleet cutter by means of a series of post cards. Each of these illustrates the sleet cutter as attached to the trolley harp, calling attention to its low price and the ease with which it can be attached. The part bearing against the trolley wire is of soft copper and may be easily replaced when worn out.

THE WESTERN ELECTRIC COMPANY recently received an order from the Raritan River Railroad Company for telephone selectors and associated telephone equipment to equip its line running from South Amboy, N. J., to New Brunswick, N. J., with a branch off from Sayreville Junction to Sayreville, and another from Serviss Junction to Lyles. The dispatcher for these circuits will be located at South Amboy.

THE PERLESS ELECTRIC COMPANY, Warren, O., makes a preliminary announcement of its 1912 motors, calling attention to the results attained in its twelve years of experience in motor manufacture, and the success of the Peerless alternating-current apparatus. The leaflet in which this announcement is made lists sixty-cycle constant-duty motors. Peerless type "W" bipolar motors are listed in a small booklet recently mailed.

THE OKONITE COMPANY, 253 Broadway, New York City, has published an attractive booklet entitled, "Economy in Joint Making, With Instructions." It contains information which should be very much in demand just as this season of the year, as now is the time to make repairs in the way of insulating and protecting joints so that short circuits, with their accompanying troubles, may be avoided during the winter to come. Copies of the booklet can be secured on application to the Okonite Company.

THE ARCHBOLD-BRADY COMPANY, Syracuse, N. Y., has done a large amount of work in the past few years in the way of manufacturing steel structures for supporting and anchoring electric transmission lines and overhead contact systems for electric railways. This work is described in a bulletin which has recently been distributed, the large number of illustrations shown therein conveying an excellent idea of the structures which have been installed. A short description giving vital facts accompanies each illustration.

JAMES G. BIDDLE, Philadelphia, Pa., has instituted in its new offices in the Boyertown Building a permanent exhibition of precision testing instruments. These are primarily Siemens & Halske instruments although some made by Otto Wolff, Cambridge Scientific Instrument Company, Ruhstrat, Evershed & Vignoles and other firms will be shown. This exhibit is described in a recent booklet. A booklet mailed at the same time gives a list of a number of typical "Megger" users. A pamphlet of representative commendatory letters has also been distributed.

THE NATIONAL X-RAY REFLECTOR COMPANY, Chicago, Ill., has issued to its customers a set of catalogs, photographs and illustrated articles bound in an attractive flexible-cover binder. The photographic prints which are one of the most striking features of the set, show distinctive installations of the Curtis Eye Comfort system of indirect illumination, and are mounted on heavy paper. In connection with each is a short paragraph explaining some feature of the building lighted or its illumination. The publications are fixed loosely in the binder so that additions or substitutions may be made as required.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburgh, Pa., has issued descriptive leaflet No. 2378, covering rotary converters for railway service. This is a four-page leaflet, nine and a half by eleven inches, and contains quite a number of illustrations describing the various parts of rotary converters, such as armature coils, spider, equalizer connections, collector rings, commutator brush riggings, etc. Under each picture is given a short description of the method of construction of the part illustrated. One page is devoted to pictures of the rotary converters completely assembled.

THE UNITED STATES ELECTRIC COMPANY, New York, N. Y., recently received an order from the New York Central Railroad for 249 selector-box outfits which will be used in the extension of its system over twelve circuits. These selectors, like the others in service on that road, are the Gill bridging telephone selector and are arranged for ringing the signal bell with the main line battery. The Baltimore & Ohio Railroad, also an extensive user of Gill selective telephone-dispatching apparatus, has placed orders with the United States Electric Company for ninety-six box outfits, equally divided between train wire and message circuit equipment. The message circuit outfit has the intercommunicating features and is equipped for time transmission. The entire order is for the local battery type and in addition an existing circuit of twenty-seven main line bells is to be changed to the local battery type. The auxiliary apparatus in this order includes twenty-nine of the United States Electric Company's new universal intercommunicating calling keys, 110 of the Company's new jack-type test panels, sixty-nine blocking sets, thirty switching cabinets and a full equipment of dispatcher's terminal apparatus or signaling sets, keys for switching the dispatcher's telephone from the train to the message wire, and vacuum lightning arresters for protection of the apparatus.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., recently received from the Appalachian Power Company an order for hydroelectric machinery to be used in developments in Virginia. This order covers apparatus for two generating stations and a transformer station, and includes: four 4,000-kilovolt-ampere, three-phase, waterwheel-driven generators, two 250-kilowatt exciters, three 2,300-kilovolt-ampere, three-phase, waterwheel-driven generators, two 150-kilowatt exciters, four 6,000-kilovolt-ampere, three-phase, water-cooled transformers, one switchboard and lightning arrester equipment. Apparatus for several substations is as follows: nine 1,500-kilowatt, oil-cooled transformers, three 500-kilowatt transformers, five motor-generator sets, switchboards. The above apparatus is for two of five waterpower developments which this company owns on the New River in Carrol, Grayson and Pulaski counties, Virginia. The power will be transmitted at 13,200 volts to a transformer station about a mile from the generating stations and will there be stepped up to 88,000 volts for transmission to the city of Bluefield and the Pocahontas coal regions, about forty-five miles distant. The transmission line will be in duplicate, one line going by way of Wytheville and the other by way of Pulaski. Power will also be distributed to other mines and cities in the surrounding country.

DATES AHEAD.

Association of Railway Electrical Engineers. Annual convention, Hotel La Salle, Chicago, November 7-10.

Alabama Light and Traction Association. Montgomery, Ala., November 14 and 15.

Ohio Society of Mechanical, Electrical and Steam Engineers, Canton, O. November 17 and 18.

Association of Railway Telegraph Superintendents. Joint meeting of eastern and western divisions, Chicago, Ill., November 23 and 24.

Los Angeles Electrical Exposition. Los Angeles, Cal., November 25-December 9.

National Gas and Gasoline Engine Trades Association. Annual meeting, Hotel Hollenden, Cleveland, O., December 5-8.

American Institute of Chemical Engineers. Annual meeting, Washington, D. C., December 20-22.

National Electric Light Association. Next annual convention, Seattle, Wash., June 10-14, 1912.

National Electrical Contractors' Association. Annual meeting, Denver, Colo., July 17-20, 1912.

The 1912 Boston Electric Show. Mechanics Building, Boston, Mass., September 28-October 26, 1912.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) October 24, 1911.

1,006,483. SIGN. Joshua J. Jones, Pittsburgh, Pa. Filed June 23, 1908. A channeled sign letter has its open face largely obscured by a shield leaving a light slot on each side. Incandescent lamps are mounted on the inside of the shield to illuminate the base and sides of the channel.

1,006,494. ELECTRIC BATTERY. William Morrison, Chicago, Ill. Filed Aug. 11, 1902. A gravity bromine battery has a cell made of conducting material and a bed of granular carbon in the bottom of the cell and bromine in its free state within the porous mass.

1,006,504. ALTERNATING-CURRENT SWITCH. Arthur Simon, Milwaukee, Wis., assignor to Cutler-Hammer Manufacturing Co., Milwaukee, Wis. Filed Feb. 21, 1907. Consists of an alternating-current magnet having a movable armature connected to a switch contact, the magnet being adapted to produce magnetic fluxes of different phase, and having a frame for distributing the fluxes symmetrically about a common axis in substantially the same plane to cause the magnet to attract and hold the armature.

1,006,522. CIRCUIT-BREAKER. Charles C. Badeau, Bethlehem, Pa., assignor to Roller-Smith Co., New York, N. Y. Filed Sept. 18, 1906. Has a contact-making-and-breaking arm, a roller on the arm, a handle pivoted in a stationary support and having a roller which operates directly on the first roller and an adjustable stop, which is located in a fixed position relative to the centers of the rollers when the breaker is closed.

1,006,532. PORTABLE MAGNETIC DRILL. August Casazza, Hoboken, N. J. Filed Mar. 16, 1909. Renewed Mar. 24, 1911. Combined with a body portion having electro-magnets to hold it in position for drilling is an electric signal having its push-buttons arranged at the outer ends of the magnet coils, mechanism for driving the drilling tool, a collar on the drilling tool, and hoisting and signaling means connected with the collar.

1,006,536. WELDING MACHINE. George E. Dean, Albion, Mich., assignor to Union Steel Screen Co., Albion, Mich. Filed Apr. 21, 1911. Combined with a traveling terminal member are pivoted contact members over which the terminal member is adapted to travel, and springs for yieldingly supporting the contact members in their work-disengaging positions.

1,006,537. WELDING MACHINE. George E. Dean, Albion, Mich. Filed July 13, 1911. Includes means for connecting a terminal member and a plunger bar to a source of electricity.

1,006,540. INTERNAL-COMBUSTION PUMPING ENGINE. Charles Emmons, Everett, Wash., assignor of one-third to John Sawbridge and one-third to Gustave S. Staly, North Yakima, Wash. Filed Oct. 10, 1910. Includes two electric ignition circuits which are alternately closed in two adjoining pump cylinders or drums.

1,006,560. RHEOSTAT FOR ELECTRIC MOTORS. Julius T. Kalweit and William H. Gaulke, Milwaukee, Wis., assignors to Independent Electric Manufacturing Co. Filed July 7, 1910. Relates to the construction of the contact pieces and the contact arm in a motor-starting rheostat.

1,006,569. DEVICE FOR DRIVING ELECTRIC SECONDARY CLOCKS. Gustaf Oscar Larsson, Stockholm, Sweden, assignor to Aktiebolaget L. M. Ericsson & Co., Stockholm, Sweden. Filed Oct. 26, 1908. Includes a primary and several secondary clocks, a primary clock circuit and a secondary clock circuit, a condenser in the latter and a contact operated by the primary clock to charge the condenser alternately positively and negatively, and simultaneously to discharge it through the secondary clock circuit.

1,006,591. DEVICE FOR HOLDING RECEIVERS OF TELEPHONES. Ernest L. Persons, Concord, N. H. Filed June 12, 1911. The switch hook has a long vertical extension arm for holding the receiver to the ear.

1,006,597. INSULATED RAIL JOINT. Edwards F. Schermerhorn, Brooklyn, N. Y., assignor to Rail Joint Co., New York, N. Y. Filed May 26, 1911. Has head insulation for its leaving rail, corresponding metal fillers for the head of its receiving rail, and a base insulation for the rail flanges that extend the full length of the joint.

1,006,608. COMBINED FIRE AND BURGLAR ALARM. James M. Walker, Quill Lake, Saskatchewan, Canada. Filed Oct. 22, 1910. A telephone magneto call bell is arranged to be operated by a spring which is restrained by a cord passing over pulleys on the walls of the room and connecting to the door and window latches. Burning of the cord or tampering with the latches releases the magneto call.

1,006,612. ELECTROLYTIC METER. Ezechiel Weintraub, Lynn, Mass., assignor to General Electric Co. Filed Feb. 14, 1910. Comprises a vessel for the electrolyte, a container for a mercury anode depending from the upper part of the vessel, a reservoir for mercury conected to the container, and pneumatic means for driving mercury from the reservoir into the container.

1,006,615. CENTRAL-ENERGY TELEPHONE SYSTEM. Charles S. Winston, Chicago, Ill., assignor to Kellogg Switchboard & Supply Co., Chicago, Ill. Filed Mar. 10, 1906. Relates to an arrangement of line, cut-off and supervisory relays and signals.

1,006,619. PROTECTION OF HIGH-TENSION DIRECT-CURRENT MOTORS IN SERIES. Thorsten von Zweigbergk, Southport, England, assignor to General Electric Co. Filed Mar. 28, 1910. Combined with a number of electric motors connected in series, is a circuit-breaker in series with the motors, and means whereby, when any one of the motors flashes over, the circuit-breaker is connected directly with the motor.

1,006,620. TUNGSTEN FURNACE. Axel Appelberg, Schenectady, N. Y., assignor to General Electric Co. Filed Oct. 16, 1908. In an electric furnace, the combination of a tubular tungsten heater, and means for maintaining a hydrogen atmosphere circulating in and about the heater while material to be heated is being introduced therein.

1,006,631. SYSTEM OF ELECTRICAL DISTRIBUTION. William H. Clarke, Chicago, Ill. Filed July 1, 1907. A lamp regulator consists of a subdivided variable resistance whose sections are successively connected into or out of circuit by means of a series of electromagnetic switches governed by a controlling magnet.

1,006,635 and 1,006,636. SPACE TELEPHONY. Lee de Forest, New York, N. Y., assignor to De Forest Radio Telephone Co. Filed July 8, 1907. The transmitting system consists of a transmitting antenna, a number of oscillation circuits having the same time period associated with and operating to produce electrical oscillations in the antenna, a number of transmitting devices arranged in circuit with the antenna at points having practically zero potential and operating to modify the oscillations in the antenna, and means common to all the transmitting devices for simultaneously controlling the same.

1,006,651. ELECTRIC-LIGHT-SOCKET CAP. John H. Goss, Waterbury, Conn., assignor to Scovill Manufacturing Co., Waterbury, Conn. Filed Jan. 3, 1911. Has a thick, metal, upright circular flange which engages the hub and prevents its rotation.

1,006,655. ELECTRIC RESISTANCE. Robert Charles Harris, Gatesnead, England, assignor to Clarke, Chapman & Co., Ltd., Gateshead, England. Filed Feb. 18 1911. A resistance unit comprises a metal strip having perforations spaced throughout its length, and folded intermediate of the perforations so as to bring the latter into alignment, and a support extending through the perforations.

1,006,657. VAPOR ELECTRIC DEVICE. Joseph L. R. Hayden, Schenectady, N. Y., assignor to General Electric Co. Filed April 16, 1907. A mercury-vapor rectifier has a condensing chamber communicating through a relatively small opening opposite the cathode with the space surrounding the electrodes and a metal shell inclosing a portion of the condensing chamber remote from the opening electrostatically to attract gases segregated within the envelope and means for maintaining the shell at a potential differing from the cathode .

1,006,669. AUTOMATIC PLAYER FOR MUSICAL INSTRUMENTS. Norman G. Meade, Wilkinsburg, Pa., assignor of one-half to John B. Comstock, Edgewood Park, Pa. Filed Mar. 25, 1907. An electric motor drives both the rolls and an exhaust air pump. Electroresponsive devices automatically reverse the rolls, disconnect the pump from the motor and finally stop the latter.

1,006,673. COMMUTATOR OF DYNAMO-ELECTRIC MACHINES. Charles Algernon Parsons, Alexander Henry Law, and Joseph Pearce Stockbridge, Newcastle-upon-Tyne, England; said Law and Stockbridge assignors to said Parsons. Filed April 9, 1910. Comprises longitudinally grooved conducting segments, insulation between the segments, a central sleeve, longitudinal projections on the sleeve engaging with each segment within

the grooves, and insulation and wedging means between the projections and segments.

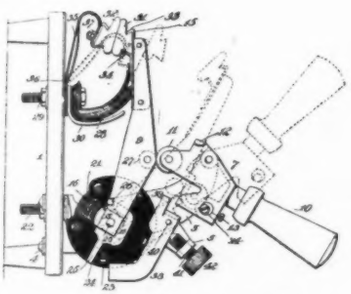
1,006,678. IGNITION SYSTEM. Henry J. Podlesák, Chicago, Ill. Filed Nov. 12, 1910. Includes a magneto, a make-and-break device, a condenser and transformer whose secondary is connected to the spark plug.

1,006,684. ELECTRICALLY OPERATED VIBRATOR. Harry Z. Sands, Cleveland, O., assignor to Royal Specialty Co., Cleveland, O. Filed July 10, 1908. Combined with the applicator and its spindle is an eccentric operating connection between the spindle and motor shaft and a balancing weight attached to the end of the shaft next to the eccentric operating connection and adapted to neutralize the vibrations to the casing.

1,006,697. ACID-PROOF ELECTRIC-BATTERY TERMINAL. Kenneth Rawlings Smith, Totnes, England. Filed Feb. 15, 1907. Consists of a lead post externally threaded at its upper end, an internally threaded celluloid tube secured to the post with its upper end projecting above the top of the post, and a celluloid screwed plug fitting the interior of the celluloid tube and carrying the conducting wire axially therein.

1,006,703. RELAY. Arthur L. Townsend, Washington, D. C., assigor of one-half to Albert A. Lohr, Washington, D. C. Filed March 23, 1911. Comprises a differential armature polarizing magnet including a slow-acting coil and a quick-acting coil connected in parallel in the line circuit.

1,006,727. AUTOMATIC FLATIRON. Archibald S. Cubitt, Pittsfield, Mass., assignor to General Electric Co. Filed May 7, 1910



1,006,522.—CIRCUIT-BREAKER.

An electrically heated flatiron has a switch for controlling the heating circuit biased to open position mechanism controlled by the hand of the operator in grasping the handle of the iron for closing the switch and thermostatically controlled means for locking the mechanism in closed-circuit position.

1,006,729. ATTACHMENT FOR VAPOR LAMPS. Alexander Dempster, Schenectady, N. Y., assignor to General Electric Co. Filed Nov. 9, 1905. Renewed Apr. 4, 1908. Combined with a mercury-vapor lamp are means for shunting the lamp with a number of sustained arcs and for gradually increasing the length of the arcs, and a retarding means to govern the speed of this increase in length.

1,006,731. RUNNING GEAR FOR ELECTRIC LOCOMOTIVES. George H. Downs, Portland, Oreg., assignor of one-half to William E. Grace, Portland, Oreg. Filed Nov. 13, 1908. The main power equipment is mounted on a depressed floor in the middle of the locomotive between the end trucks. Each truck comprises six driving wheels preceded by a small four-wheel bogie truck.

1006,732. DRIVING MEANS OF ELECTRIC LOCOMOTIVES. George H. Downs, Portland, Oreg., assignor of one-half to William E. Grace, Portland, Oreg. Filed Nov. 13, 1908. Prime movers drive electric generators that supply current to motors mounted on the driving trucks, the motors being connected to the driving axles by means of sprockets and sprocket chains.

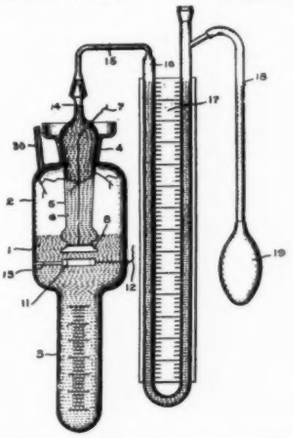
1,006,744. DYNAMO-ELECTRIC MACHINE. Valère Alfred Fynn, London, England, assignor to Wagner Electric Manufacturing Co., St. Louis, Mo. Filed May 26, 1910. Combined with a stator provided with an exciting winding and a neutralizing winding is a rotor having exciting brushes displaced from the axis of the exciting winding and in circuit with the winding, the brushes being connected to carry all the current producing the flux which threads the machine at right angles to the neutralizing winding, and working brushes displaced from the exciting brushes and connected in series with the neutralizing winding.

1,006,749. CONTROL MECHANISM. Harry Haudenschild, Toledo, O., assignor to F. Bissell Co., Toledo, O. Filed Jan. 20, 1908. Comprises a spool, a resistance conductor wound about the spool, a rotary member within the spool, a traveling contact carried by the rotary member, co-operating stationary contacts within the spool, and a spring surrounding the axis of the rotary member and actuating it in one direction.

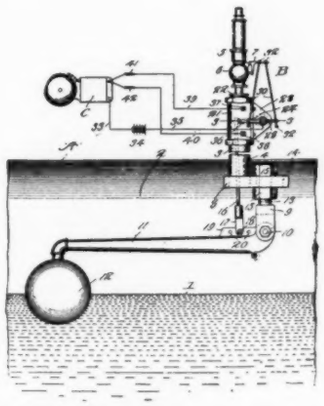
1,006,751. ENGINE CONTROL. Harry Hertzberg and Maurice J. Wohl, New York., N. Y., assignors to Abbot A. Low, Horseshoe, N. Y. Filed Dec. 2, 1909. The stroke of the valve in a reciprocating engine is varied by a motor-driven worm gear acting through an arm. As the speed of the engine varies, a switch-bar oscillating between two sets of contacts reverses the motor. Means are provided for adjusting the periods of contact between the switch-bar and the speed-governed means to vary the limits of speed at which the stroke of the valve will be changed.

1,006,756. ELECTRIC BRANDING DEVICE. James Andrew Jordan, Bangor, Ireland. Filed Feb. 25, 1911. The brand plate is screwed onto a metal body which is provided with handles for manipulating. The heating element is secured between the body and brand plate, being insulated from the body.

1,006,766. LOCKING DEVICE FOR ARC-LAMP HANGERS. Clarence W. Mansur, Lynn, Mass., assignor to General Electric Co. Filed Mar. 5, 1910. A plunger provided with a shoulder is received in a casing and held in position by a ball which falls in position under the shoulder. Means are provided for alternately bringing the ball into engaging and disengaging positions by successive upward movements of the plunger.



1,006,612.—ELECTROLYTIC METER.



1,006,898.—WATER-LEVEL ALARM.

1,006,767. ELECTRIC HAIR-DRIER. Henry J. Mauger, Schenectady, N. Y., assignor to General Electric Co. Field Jan. 19, 1910. Air set in motion by a small motor-driven fan is blown over an incandescent lamp set in its path and is thereby heated.

1,006,786. SPACE TELEGRAPHY. George Samuel Piggott, Chicago, Ill., assignor of one-tenth to Roy D. Read, Chicago, Ill. Filed June 19, 1903. Consists of a static direct-current generator, sparking terminals connected directly to the opposite poles of the generator and a signaling switch controlling the flow of current between the terminals.

1,006,795. SPARK-GAP. James D. Robertson, Toledo, O., assignor to Champion Spark Plug Co., Toledo, O. Filed Nov. 30, 1910. One end of a barrel of non-conductive material is closed. The other end is open and threaded. A fixed electrode is carried by the closed end of the barrel, a movable electrode extending from the inner end of a threaded plug screwed in the open end. The distance between electrodes is varied by turning the plug.

1,006,802. AUTOMATIC CIRCUIT-CONTROLLER FOR ELECTRIC MOTORS. Simon Sparrow, St. Louis, Mo., assignor to Wagner Electric Manufacturing Co., St. Louis, Mo. Filed May 27, 1909. A pair of wing-shaped weights surround a rotating shaft, these being pivoted to the shaft. A longitudinally moving member provided with teeth and engaging with the weights is arranged at the side of the shaft.

1,006,805. MERCURY-VAPOR DEVICE. Elihu Thomson, Swampscott, Mass., assignor to General Electric Co. Filed Jan. 21, 1911. A hermetically sealed receptacle is filled with gas under pressure. Mercury is contained in an open ended refractory envelope in the receptacle. A piston which slides in the open ends of the envelope moves so as to break the continuity of the mercury body, striking an arc.

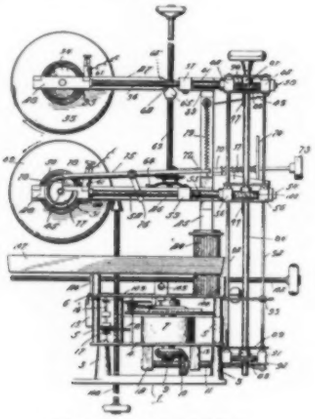
1,006,824. ALARM-ACTUATING MECHANISM FOR INCUBATORS. Walter Martin Braly, Blackwell, Okla. Filed April 2, 1910. A contact member controlled by a thermostat is moved as temperature varies, contact being made and signals given when certain temperature limits are exceeded. Means are supplied for holding the contact member yieldingly in a predetermined position.

1,006,833. TELEPHONE RECEIVER. William W. Dean, Elyria, O., assignor to Dean Electric Co., Elyria, O. Original application filed Oct. 8, 1908. Divided and this application filed Nov. 1, 1909. The telephone receiver is made in two parts, a body portion and a cap, each being formed out of thin sheet material. As the material is too thin to allow the cutting of threads provision is made for upsetting the end of each part and then forming threads thereon.

1,006,835. MAGNETIC SEPARATOR FOR ORES. James B. Etherington, Winthrop, Mass., assignor to Campbell Magnetic Separating Co. Filed Jan. 24, 1910. An inclined table supported by a frame receives the untreated ore. Separation is accomplished by a horse-shoe magnet pivotally mounted on the frame in such a way that the table is between the poles.

1,006,836. PROCESS AND APPARATUS FOR ELECTROLYTIC RECOVERY OF WASTE LIQUOR. Frederick F. Farnham, McKeesport, Pa., assignor to National Tube Co., Pittsburgh, Pa. Filed Aug. 11, 1911. Consists in part of treating solutions of sulfate of iron, by subjecting the solution to the action of an electric current passing from an anode through a diaphragm to a cathode, thereby depositing iron on the cathode and forming sulfuric acid at the anode, and passing the solution through the diaphragm and perforations in the anode.

1,006,864. ELECTROTHERAPEUTIC APPARATUS. Mark G. McElhinney, Ottawa, Can. Filed March 15, 1910. Comprises a plate of dielectric material, condenser plates secured on both sides of the dielectric plate, electrical connections from one of the condenser plates to a suitable source of electric energy and an electric conductor held by a spring in proximity to the electrically connected condenser plate and electrically connected to a suitable source of electric energy.



1,007,003.—ARC LAMP.

1,006,884. ELECTRIC-LAMP SOCKET. Frank E. Seeley, Bridgeport, Conn., assignor to Bryant Electric Co., Bridgeport, Conn. Filed April 4, 1910. Comprises an insulating body with a switch chamber and with wire terminals and lamp terminals, two spaced contacts in each branch of the circuit, in the switch chamber, a movable switch plate carrying contacts on its opposite faces, and a key spindle and a spring to actuate the switch plate to make and break the circuit at both spaced contacts on each branch.

1,006,887. ELECTRIC RAT TRAP. Károly Stefán, West Philadelphia, Pa. Filed July 24, 1911. As the rat steps upon a platform this is tilted, throwing the rat across the terminals of an electric circuit.

1,006,898. WATER-LEVEL ALARM FOR BOILERS. Lewis Beebee, Saginaw, Mich. Filed April 15, 1910. Combines a steam-whistle alarm with an electric bell, both of which operate when the water level rises too high or exceeds a low-water limit. Both the electrical contact and the blowing of the whistle are effected through a pivoted member operated by an arm which carries a float.

1,006,901. RAILWAY SIGNAL. Andrew H. Bernadou, Philadelphia, Pa., assignor of one-half to Harry Grass, Philadelphia, Pa. Filed May 26, 1908. Each block forms a normally closed track circuit and each block is supplied with two pair of contacts, one controlling the signals of the block ahead and the other controlling the signals of the second block in advance. Two bells of different tone are carried by the train, these being actuated by the track contacts.

1,006,910. ELECTRIC TRAP. Malcolm Cole, McKees Rocks, Pa. Filed March 14, 1911. The animal steps on a tiltable plate and is electrocuted when the lid tips and he is thrown between the two terminals of an electric circuit.

1,006,963. ROCKING CHAIR. Mike Lutenberger, Blocton, Ala. Filed April 21, 1911. An electric fan with a storage battery is placed in a housing under the seat of a rocking chair.

1,006,996. CIRCUIT-CLOSER FOR TROLLEY-SIGNALS. Winthrop M. Chapman, Needham, Mass., assignor to Electric-Railway Signal Co., Kittery, Me. Filed May 28, 1908. Comprises a terminal, a circuit-closing member for engaging the terminal, means for moving the member to break the circuit thus formed, a mechanical retarding device including an escapement wheel and a pallet permitting movement of the circuit-closing member, and acting to retard the movement of the member, this retarding device having provision for limiting the period of time during which it acts to permit a quick break.

1,007,003. ARC LAMP. John W. Kendrick, Franklin, Pa., assignor of one-half to Ira Griffen, Franklin, Pa. Filed Feb. 17, 1910. Has rotatable disk-electrodes journaled in pivoted arms, rotatable shafts for revolving the electrodes, the shafts being journaled in bearings attached to the arms, and driving-shafts flexibly coupled to the rotatable shafts. The latter shafts may have, with the pivoted arms, a rising and falling movement, and the electrodes may be revolved.

1,007,026. VAPOR-DIFFUSING DEVICE. Harry W. Forbes and Frederick Linick, Chicago, Ill. Filed Nov. 16, 1910. A container with a dropper is attached to the front of an electric fan. The liquid falls into a foraminated receptacle through which the air is blown, carrying the vapor of the liquid with it.

1,007,030. TELEPHONE TRANSMITTER. Albert A. Jahnke, Richmond, Cal., assignor to National Wireless Telephone & Telegraph Co. Filed Nov. 18, 1910. Comprises a tubular conduit for conducting a fluid stream in the transmission circuit, a diaphragm, and means connected with the diaphragm for varying a cross-sectional area of the conduit, substantially as described.

1,007,031. MICROPHONE TRANSMITTER. Albert A. Jahnke, Richmond, Cal., assignor to National Wireless Telephone & Telegraph Co. Filed Nov. 18, 1910. Serial No. 592,951. Carbon granules are placed in the transmitter, a receptacle containing a volatile liquid being separated from the granules by a porous wall. There is also included a diaphragm for receiving sound vibrations, and a connection between the diaphragm and one of the terminals, whereby the distance between the terminals is varied with the vibration of the diaphragm. Circulation of said liquid through the receptacle is maintained.

1,007,036. TELEPHONE SYSTEM. Albion D. T. Libby, Elyria, O., assignor to Dean Electric Co., Elyria, O. Filed May 28, 1909. Has means for signaling the called subscriber, means for retiring such signal when the subscriber responds, and a second means for actuating the signal when the trunk is disconnected from the called line, the two signal actuating means so related that the actuation of either will operate the signal when the other means is not operated.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States patent office) that expired October 30, 1911:

528,184. ELECTRIC-ARC LAMP. Rudolph Segerdahl, Chicago, Ill.

528,185. AUTOMATIC ELECTROMAGNET CUT-OUT. Lucius T. Stanley, Brooklyn, N. Y.

528,188. ELECTRIC TRANSFORMER. Elihu Thomson, Lynn, Mass.

528,189. THERMOSTAT. David W. Thompson, Chicago, Ill.

528,204. ARMATURE FOR DYNAMO-ELECTRIC MACHINES AND METHOD OF MAKING SAME. Thomas H. Hicks. Detroit, Mich.

528,205. CONDUIT ELECTRIC RAILWAY. Julius L. Horning, St. Louis, Mo.

528,241. ELECTRIC LAMP SHADE. Edouard Vedovelli, Paris, France.

528,245 and 528,246. ELECTRIC RAILWAY SIGNAL. Adoniram J. Wilson, Port Chester, N. Y.

528,286. GALVANIC BATTERY. Martin M. Clarke, Chicago, Ill.

528,290. APPARATUS FOR MANUFACTURING CONDUIT SECTIONS. James F. Cummings, Detroit, Mich.

528,291. UNDERGROUND CONDUIT. James F. Cummings, Detroit, Mich.

528,301. ART OF COATING ELECTRIC CONDUCTORS. Albert F. Montgomery, Lincoln, R. I.

528,330. CONDUIT SYSTEM FOR ELECTRIC RAILWAYS. John B. Linn, Cleveland, O.

528,379. CLOSED-CONDUIT ELECTRIC RAILWAY. James F. McLaughlin, Philadelphia, Pa.

528,430. ELECTROMAGNETIC SWITCH. John G. Hartel, Keokuk, Iowa.

528,438. SAFETY DEVICE FOR ELECTRIC CARS. John M. Kelly, Rochester, N. Y.

528,440. REVERSING MECHANISM FOR ELECTRIC MOTORS. John Mellen, Newport, Ky.

528,444. ELECTRIC SIGNALING APPARATUS FOR BLOCK SYSTEMS. Matthew S. Reilev, Washington, D. C.

528,445. SECONDARY BATTERY. John E. Rheth, Salem, Ind.

528,465. ELECTRIC MACHINE FOR RAILWAY SYSTEMS. Edward Deming, New York.

528,477. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS. Charles H. Harkins, St. Louis, Mo.

528,494. CLOSED CONDUIT FOR ELECTRIC RAILWAYS. William E. Stearns, Berlin, Conn.